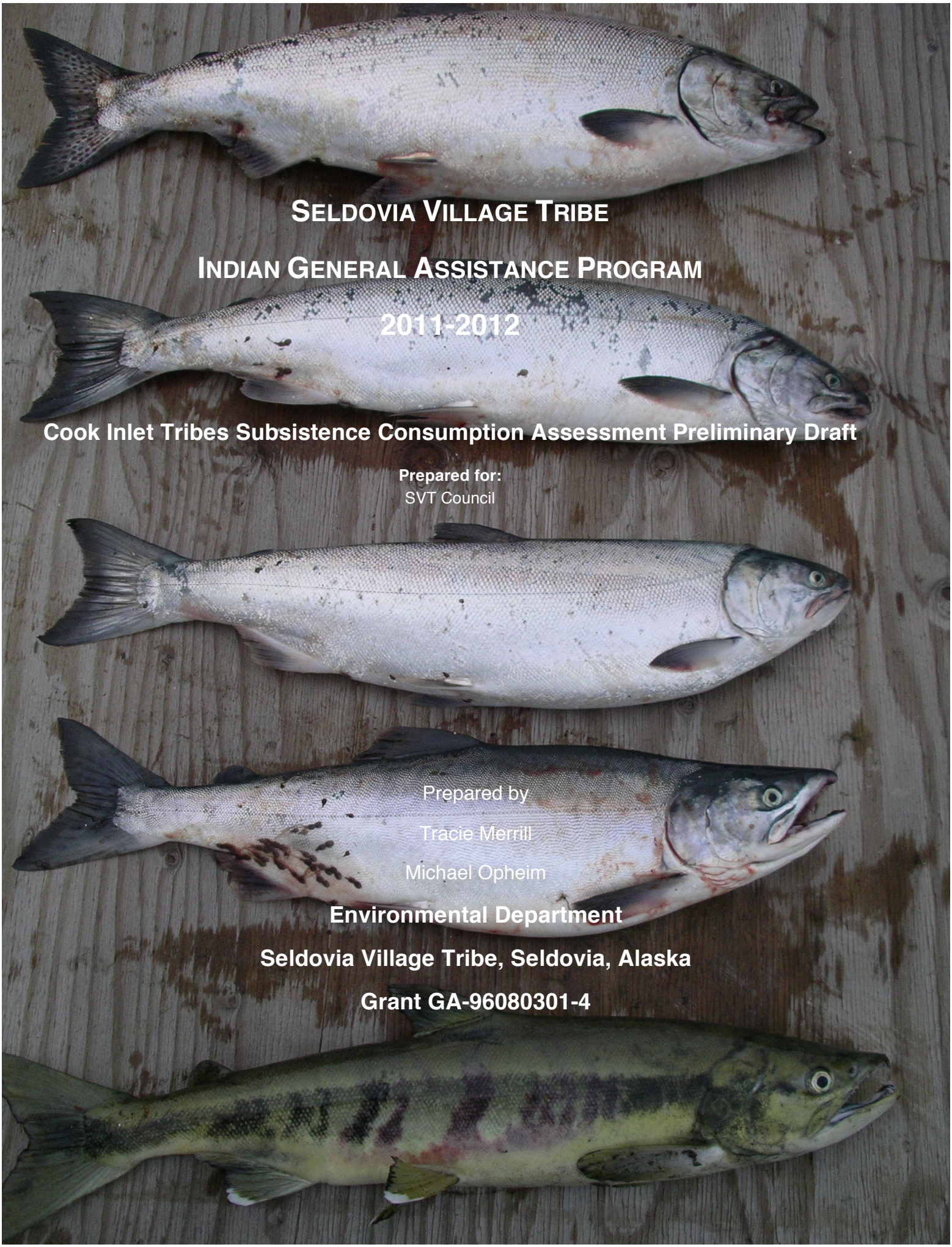

SELDOVIA VILLAGE TRIBE

INDIAN GENERAL ASSISTANCE PROGRAM

2011-2012

Cook Inlet Tribes Subsistence Consumption Assessment Preliminary Draft

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3. ABSTRACT

The Seldovia Village Tribe has participated in the Indian General Assistance Program (IGAP) under assistance agreement GA-96080301-4 during FY11-FY12. This report is intended to meet the requirements of the workplan under this agreement. Working in the IGAP program gave us this opportunity to answer questions we have had for some time now and build capacity in our program by obtaining information on the consumption of fish, invertebrates, and marine mammals in the Cook Inlet. Given that this important information is unknown and that the daily rate of fish consumption for Cook Inlet tribal members was estimated to be dramatically higher than the national average estimated by EPA, the Seldovia Village Tribe (SVT) proposed to conduct a much more comprehensive study/assessment of fish consumption, and risk of contaminant exposure through this consumption, for Alaska natives of the Cook Inlet area. This study was planned in two phases. The first phase (phase 1) was a very thorough consumption assessment of fish, as well as several other subsistence foods, of tribal members from the villages of Seldovia, Port Graham, Nanwalek, and Tyonek. The second phase will involve actual testing of contaminant levels in 2013/2014 of fish caught within the waters of Cook Inlet, as well as other subsistence foods, revealed to be consumed frequently and/or in large quantities by tribal members.

4. ACKNOWLEDGEMENTS

Seldovia Village Tribe (SVT) would like to thank the US Environmental Protection Agency (EPA) for funding this assessment through the Indian General Assistance Program (IGAP). We would further like to thank the Columbia River Inter-Tribal Fish Commission. Their 1994 fish consumption survey technical report of the Umatilla, Nez Perce, Yakama, and Warm Spring tribes provided the template, and framework, for the methodology and design of the questionnaire used in our assessment. Portions of our Quality Assurance Project Plan (QAPP) were also modeled after a similar plan developed by the Wampanoag Tribe of Gay Head. We wish to acknowledge the Alaska Native Tribal Health Consortium (ANTHC) for their assistance

with statistics, as well as data analysis and verification. We are also especially grateful to tribal members living in Port Graham, Nanwalek, Tyonek, and Seldovia who contributed their time to participate in the assessment. This assessment would not have been completed without their support and participation.

5. INTRODUCTION

Between November 2011 and September 2012, Seldovia Village Tribe staff undertook a subsistence consumption assessment (i.e. survey) of Cook Inlet tribal members through EPA IGAP special project funding. This assessment involved an interview-based survey that examined subsistence food consumption rates, and patterns, of Alaska Natives residing in Seldovia, Port Graham, Nanwalek, and Tyonek. Community members of these villages frequently consume and harvest traditional foods from the waters of Cook Inlet. This is the first assessment to collect fish consumption rates and patterns of Alaska natives living in Cook Inlet in regards to fish preparation methods, cooking methods, breast feeding, and elementary age children.

5.1 Assessment objective

The objective of this assessment was to ascertain individual tribal members' consumption rates, patterns, habits, and preparation methods of anadromous and resident fish species caught within Cook Inlet waters as well as other marine species (non-fish species) harvested traditionally by tribal members as food sources. This assessment was undertaken due to concerns of contaminants in Cook Inlet waters and that current fish consumption rates used by agencies, such as the US Environmental Protection Agency (EPA) and Alaska Department of Environmental Conservation (ADEC), for developing human health based water quality criteria in Alaska may greatly be underestimating the amount of fish eaten, on a daily basis, by Cook Inlet tribal members. If Cook Inlet tribal members do have significantly higher fish consumption rates then those currently being used by EPA and ADEC, then current water quality criteria may not be adequately protecting the health of tribal members from exposure to contaminants.

5.2 Background

5.2.1 Inaccurate estimates of per capita fish consumption in the United States

Located on the Kenai Peninsula of south-central Alaska, Seldovia, Port Graham, and Nanwalek have been home to native people for thousands of years. Tyonek is a native village located in the upper Cook Inlet area, about 40 air miles south of Alaska's largest city, Anchorage. Native people have resided in Tyonek, as well, for thousands of years. For as long as the people of Cook Inlet have resided here, they have depended upon and harvested, the rich marine resources of Cook Inlet. Fish, especially salmon, are extremely important to tribal members. Salmon is a major food source as well as part of the cultural and economic well being of the tribes. Interest in conducting an assessment of tribal members regarding

subsistence foods came from the US Environmental Protection Agency (EPA) investigations of human health risks posed from exposure to chlorinated dioxins, mercury, and other toxins through ingestion of contaminated fish and other marine foods (ATSDR 2009). EPA uses a national average fish consumption rate of 17.5 grams per day (g/d) for developing human health based water quality criteria in Alaska. A fish consumption rate of 17.5 g/d equals about 0.6 ounces per day or three 6-ounce meals per month (Powell 2011). In Alaska, the Department of Environmental Conservation (ADEC) uses a fish consumption rate of only 6.5 g/d to calculate human health based water quality criteria (Powell 2011). These estimates are questioned as being too low for Alaska Natives considering a more recent study done by the Agency for Toxic Substances and Disease Registry (ATSDR) indicated Alaska natives living in Cook Inlet may consume up to 7 oz., or 198.45 grams, of fish per day (ATSDR 2009) and studies of tribes in Oregon and Washington who have similar diets to Alaska Natives indicated they consume, on average, 58.7 g/d of fish (Columbia River Inter-Tribal Fish Commission 1994). Cook Inlet tribes and Columbia River Basin tribes share concerns of exposure to these types of contaminants (ATSDR 2009, EPA 2002).

5.2.2 Degraded water quality

The health of Cook Inlet has long been a priority to tribal members. Within Cook Inlet, there exist many sources of pollution. On and offshore oil and gas activities occur within the upper portions of Cook Inlet. Since drilling operations began in the 1960s, offshore drilling for oil and gas in Cook Inlet has generated more than 978 million barrels of treated wastewater (ATSDR 2009). While some of the Cook Inlet platforms separate and treat production fluids (oil, gas, and water) right at the platforms and then directly discharge the production water into Cook Inlet, others pipe production fluids to three shore-based facilities (Granite Point, Trading Bay, and East Foreland) for separation and treatment. Production water from these shore-based facilities is discharged to Cook Inlet following treatment (either directly from the on-shore facilities or from platforms). Contaminants generated from these operations enter Cook Inlet through the treated wastewaters and drilling mud (ATSDR 2009). Chemicals found in treated wastewater and drilling mud include oil, grease, mercury, cadmium, barium sulfite, and chemical additives such as flocculants, oxygen scavengers, biocides, cleansers, and scale corrosion inhibitors. It is estimated that 253 tons of oil are discharged into Cook Inlet, alone, from treated wastewaters each year (MMS 2003). Additionally, Cook Inlet receives about an average of 182.3 thousand cubic meters per day (182.3 thousand tons per day) of wastewater from 10 municipalities (MMS 2003). While Tyonek is within 10 miles of the nearest oil and gas operation in Cook Inlet, Seldovia is approximately 117 miles away, and Port Graham and Nanwalek are about 128 miles away from this operation (USEPA 2000, 2003).

For human health risk assessment purposes, an individual's rate of fish and shellfish consumption is a key exposure variable. Ingestion of contaminated fish is one of the most significant pathways of human exposure to toxic chemicals in aquatic environments (ATSDR 2009). Moreover, because waterborne toxins tend to bioaccumulate in aquatic organisms, those who consume fish can be exposed to significantly higher doses of certain chemical contaminants than from water and atmospheric sources combined (ATSDR 2009). Traditional

foods comprise 40 percent to 90 percent of rural Alaskan diets and, therefore, high levels of contaminants in fish, as well as other resources, can be especially dangerous to Alaska Natives (ATSDR 2009). A survey of chemical contaminants of fish, invertebrates, and plants collected in the vicinity of Seldovia, Tyonek, Port Graham, and Nanwalek in 1997 detected global contaminants (mercury, organochlorine pesticides, and PCB congeners) as well as several individual PAH compounds and one type of dioxin (EPA 2003).

6. METHODOLOGY

6.1 Sample design

6.1.1 Sample frame

Announcements were posted in each participating village about the assessment and descriptions for interviewer positions. Two interviewers were selected from each participating village and contracted by SVT to conduct the preliminary work, as well as carry out, the assessment following the approved documents and methods outlined in the QAPP SVT provided. Selection of tribal members participating in the assessment was random thus eliminating any potential bias from interviewers. Respondents were randomly selected from tribal member registry lists. These lists are updated continuously by tribal staff and used to determine an individual's eligibility to receive services and benefits from tribal programs.

6.1.2 Sample size and tribal representation

At the time of this assessment, based upon tribal registry lists, there were 42 adult (18 years of age or older) tribal members living in Seldovia, 90 in Port Graham, 250 in Nanwalek, and 104 in Tyonek (representing 34, 54, 65, and 77 tribal households, respectively). Based upon the resident tribal household population (34) of Seldovia, a sample size of 19 completed interviews was sought (each from a different household) from each village. "Resident" was defined as living the majority of time in each village. Because tribal populations varied by each village, a consistent sample size (19) was obtained for each village (Figure 1a). However, whenever the data were compiled, the data were weighted based upon the number of tribal households in each village.

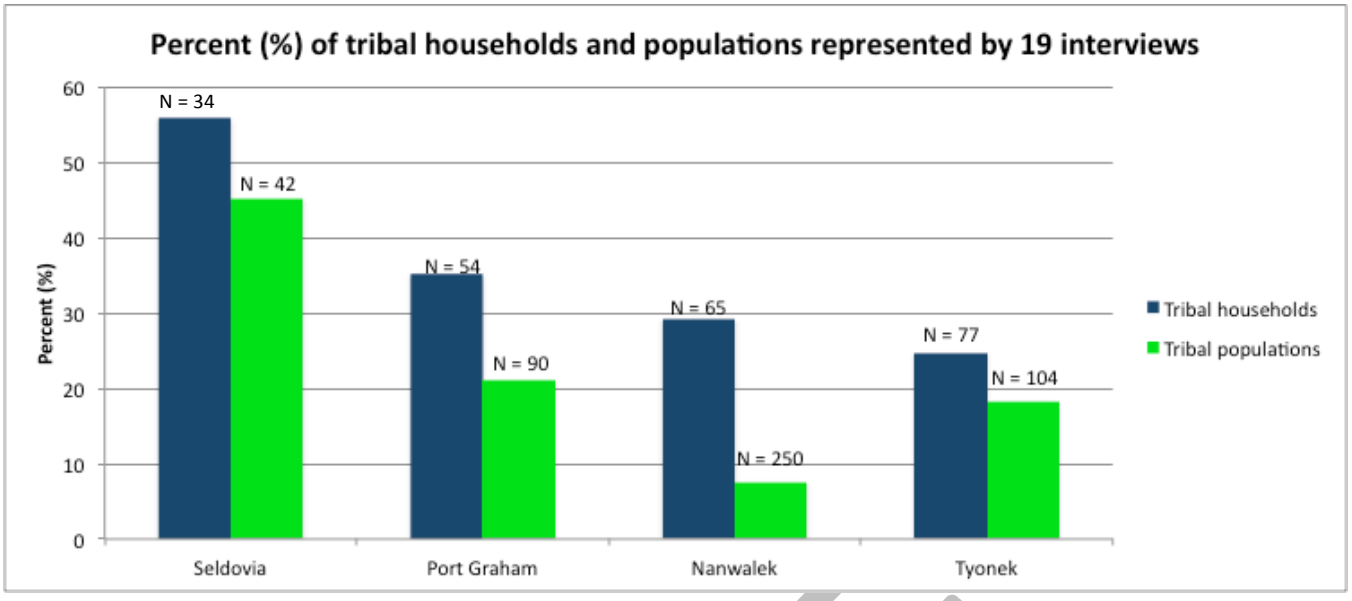

Figure 1a. Percent (%) of tribal households and populations represented by 19 interviews.

The required sample sizes for this assessment were determined by the below calculations. Confidence intervals were not calculated for each individual village although the overall sample size needed was calculated (based upon the total number of tribal households), to insure that 76 completed questionnaires would be sufficient for the level of confidence we were seeking.

Sample size necessary to calculate proportions/frequencies for population with 95% confidence assuming a confidence interval of 15:

POPULATION SIZE:

34 enrolled Tribal households in Seldovia

$$s = \frac{Z^2 * p * (1-p)}{c^2}$$

Where:
s = sample size needed
Z = Z value (1.96 used for 95% confidence level)
p = percentage picking a choice, expressed as decimal (.5 used for sample size needed)
c = confidence interval, expressed as decimal (.15 or ± 15% used for sample size needed)

s = 42.68

Correction for Finite Population

$$\text{New } s = \frac{s}{1 + \frac{(s-1)}{N}}$$

Where: N= population (34 used for sample size needed)

s = sample size from above calculation (42.68 used for sample size needed)

New s = 19.17

Sample size necessary to calculate proportions/frequencies for total population of all 4 villages (230 households) with 95% confidence assuming a confidence interval of 15:

s = 36.14.

Sample size necessary to be 95% confident of the mean consumption to within a bound of 9 grams, assuming a standard deviation of 30 grams/day:

POPULATION SIZE:

34 enrolled tribal households in Seldovia

$$n = \frac{\sigma^2}{\frac{B^2}{Z^2} + \frac{\sigma^2}{N}}$$

Where: n= required sample size

N= population (34 used for sample size needed)

σ = standard deviation (used 30 grams/day for sample size needed)

B = bound that μ is being estimated within (used 9 for sample size needed)

Z = z-score for (1- α)% confidence (used 1.96 for 95% Confidence level)

n=18.93

Sample size necessary to be 95% confident of the mean consumption to within a bound of 9 grams for total population of all 4 villages (230 households), assuming a standard deviation of 30 grams/day:

n=36.00

ESTIMATION OF THE STANDARD DEVIATION

A standard deviation of 30 grams was based on the approximation that 95% of observations fall within 2 standard deviations of the mean. In Appendix B of Volume 2: Risk Assessment

and Fish Consumption Limits – Third Edition, available at http://water.epa.gov/scitech/swguidance/fishshellfish/techguidance/risk/upload/2009_04_23_fish_advice_volume2_v2cover.pdf, Table B-3 contains mean and 95% consumption rates from several studies. In this table (Figure 1b), the 95th percentile ranges from 2 grams to 75 grams above the mean.

Table B-3. Sport Fishers[a] Consumption Data

	Consumption Rates (g/d)					
Fisher Group	Mean	Median	80th Percentile	90th Percentile	95th Percentile	Fish Type
Alabama fishers[1]	45.8				50.7	F+S, F+C
Louisiana (coastal) fishers[2]		65				F+S, F+C
New York fishers[3]	28.1					F+S, R+C
New York (Hudson River) fishers[4]	40.9					F+S, R
Michigan fishers[5]	14.5		30	62	80	F+S, R
Michigan fishers[6]	18.3			≈50		F+S, R+C
Michigan fishers[7]	44.7					F, R
Wisconsin fishers (10 counties)[8]	12.3				37.3	F, R
Wisconsin fishers (10 counties)[8]	26.1				63.4	F, R+C
Ontario fishers[9]	22.5					F, R
Los Angeles Harbor fishers[10]		37		225		S, R
Washington State (Commencement Bay) fishers[11]		23		54		S, R
Washington State (Columbia River) fishers[12]	7.7					F+S, R+C
Maine fishers (inland waters)[13]	6.4	2.0		13	26	F, R

F = freshwater, S = saltwater, R = recreationally caught, C = commercially caught.
[a] Sport fishers may include individuals who eat sport-caught fish as a large portion of their diets.

SOURCES:
1 ALDEM (1993).
2 Dellenbarger et al. (1993).
3 Connelly et al. (1990).
4 Barclay (1993).
5 West et al. (1993).
6 West et al. (1989).
7 Humphrey (1976).
8 Fiore et al. (1989).
9 Cox et al. (1993).
10 Puffer et al. (1982).
11 Pierce et al. (1981).
12 Honstead et al. (1971).
13 Ebert et al. (1993).

Figure 1b. Sports fishers' consumption data

For a conservative estimate, we set the standard deviation to 30 grams.

6.1.3 Selection procedure

Before any selection process took place, tribal members under the age of 18 were removed from the registry lists as well as known non-resident tribal members. Remaining names on the lists were each assigned a number. Using a random number generator, numbers (and the names of individuals assigned to those numbers) were selected and those individuals were contacted for interviews. Tribal members who could not be contacted after a minimum of four attempts, or refused to participate, were removed from the sample set and were replaced by

the next eligible members down the list following the same selection method as above. Attempts were made to contact selected tribal members who had no valid phone number. They were contacted in-person or were sent a letter informing them of the assessment and asking them to contact tribal staff to arrange an appointment. Tribal members were given a month to respond, and after a month they were removed from the sample pool. The tribal members residing in the same households as interviewed members were also removed from the sample set upon completion of those interviews.

6.1.4 Weighting data

Data presented in this report from individual villages were unweighted. However, whenever data were compiled, the data were weighted using the following formulas:

Weighting factor of each tribe:

$w_i = (N_h/n_h)$ where: observation i is from tribe h
N_h = the population size of households of each individual tribe
n_h = sample size of the individual tribe

*Final weighting factor for each tribe = divide each w_i by the lowest of the four numbers

For the weighted mean:

$$\bar{X}_w = \sum_{i=1}^{i=m} w_i x_i \Big/ \sum_{i=1}^{i=m} w_i$$

where: w_i = weighting factor for individual tribe
x_i = the individual data point
m = the number of data points

For the weighted variance:

$$S_w^2 = \sum_{i=1}^{m} w_i (x_i - \bar{x}_w)^2/(n-1)$$

Weighted standard error of the mean= $s_w/n^{0.5}$

6.2 Assessment methods

6.2.1 Target population

The target population included all tribal members 18 years and older who lived in Seldovia, Port Graham, Nanwalek, and Tyonek at the time the assessment was being conducted. Interviews were sought with 19 tribal members (each representing a different household) from each village. Respondents provided consumption information for themselves and the youngest

child (17 years old or younger) residing in the respondent's household. Data for these children is summarized in section 7.7 of this report. Respondents who stated they consume fish were referred to as "fish consumers" and respondents who stated they did not consume fish were referred as "non-fish consumers". Since the purpose of the assessment was to determine current consumption rates, respondents who had not eaten a species within the last year (from the date of the interview), were not considered to be eating that species.

6.2.2 Questionnaire development

The questionnaire design and content used during interviews was modeled after the survey developed by the Columbia River Inter-Tribal Fish Commission for their fish consumption survey of the Umatilla, Nez Perce, Yakama, and Warm Spring tribes of the Columbia River Basin. The questionnaire was included as an appendix with the Quality Assurance Project Plan (QAPP) developed for this project and subsequently approved by EPA in 2012.

Under the guidance of the Tribal Council, SVT environmental department staff determined the focus of the assessment, the target population, questionnaire design and content, interview procedure and methodology, and tasks necessary to complete the assessment. All of the above were referenced in the QAPP developed for the project and subsequently approved by EPA.

6.3 The assessment questionnaire

The 16-page questionnaire (in addition to several pages of maps marked by respondents) included 36 questions within 5 sections (Memory recall, Adult consumption of fish, Child consumption of fish, Adult consumption of non-fish subsistence foods, and Obtaining fish). Respondents were asked questions about their consumption of different fish species and fish parts as well as consumption of several non-fish marine foods. Questions included: demography, 24 hour dietary recall, seasonal, annual, and daily fish consumption rates, consumption of fish parts, fish preparation methods, breast feeding, Cook Inlet fishing sites, sources of fish consumed, and fish consumed as a result of cultural and social events. In addition, the consumption of several marine invertebrate species: harbor seal, beluga, and sea birds/ducks was included. If children (17 years old or younger) resided in the same household as a respondent, the respondent was also asked to provide information about the consumption of fish species and fish parts for the youngest child in that household. In order to be considered an adult, the respondent must have already reached their 18th birthday.

6.3.1 24-Hour Recall

The 24-hour dietary recall was asked of adult respondents for comparative analysis with overall individual fish consumption rates. Respondents were asked to list everything they had eaten or drank within the past 24 hours prior to the assessment along with amounts.

6.3.2 Fish

6.3.2.1 Seasonal Consumption

To better understand seasonal variation and correlations in consumption, respondents were asked to identify the two months of the year they consume the most fish and the two months they consume the least fish. Respondents were then asked to estimate the average number of fish-meals per week they consumed during the two months they identified as highest and least months of consumption.

6.3.2.2 Rate of fish consumption throughout year

Respondents were asked about the number of fish-meals they consume on a weekly basis, on average, throughout the year.

6.3.2.3 Defining and quantifying “fish-meals”

“Fish-meals” included breakfast, lunch, dinner, and snacks. Snacks included food items such as crackers with fish spread. Fish-meals were not defined by any quantified amount. Since the term “fish-meals” did not indicate a quantified amount of fish and may have reflected different amounts in ounces depending on the respondent and the meal, respondents were asked to estimate the average serving size in ounces of fish eaten during fish-meals. To aid respondents in estimating amounts of fish consumed, plastic models approximating three ounce and five-ounce fish fillets were provided.

6.3.2.4 Fish species consumed

The questionnaire asked for consumption information on 29 species of Cook Inlet fish. These species were chosen because they are known to be traditionally harvested by tribal members and because they all can be found locally at least for part of the year.

6.3.2.5 Fish parts consumed

Respondents were asked to identify the fish parts they usually consume for each fish species they identified as being “commonly eaten.” Fish parts listed on the survey were: fillet, skin, head, eggs, bones, belly fat/flaps/meat, and other organs. Respondents were also asked to provide the same information for one child 17 years of age or younger residing in the respondent’s household (if applicable). Belly fat/flaps/meat was not on the earlier version of the questionnaire form provided to Seldovia tribal members but was on the later versions provided to Port Graham, Nanwalek, and Tyonek.

6.3.2.6 Fish preparation methods

Because toxic chemicals may attenuate out of fish flesh when prepared by certain methods (ADEC 2012), respondents were asked about the different methods used to prepare fish in their homes and how often a particular method is used. The questionnaire specifically inquired about the use and frequency of the following preparation methods: pan frying, deep frying, poaching, boiling, baking, broiling, smoking, drying, eating raw, roasting, canning, and salting. Pickled fish was included under the "raw" category. Although a separate category was created for salted fish on the questionnaire form, for analysis, salted fish was considered "raw" fish. Respondents also were asked to provide information concerning how often they use each method, given the following three choices: at least once per week, at least once per month but less than once per week, or less than once per month. "Salted" was not given as an option on the original questionnaire form Seldovia tribal members responded to.

6.3.2.7 Breastfeeding

Because certain toxic contaminants can be passed to newborn infants from mother's breast milk (Nickerson 2006, Ramirez et al. 2000), all female respondents were asked whether they have given birth, and if so, the month/year of their youngest child's birth, whether that child has been, or is currently, being breast fed. Female respondents were also asked at what age their child ceased or will cease breastfeeding.

6.3.2.8 Source of fish consumed

To verify where respondents were obtaining the fish they consume, respondents were asked to estimate what percent of the fish they consume is from the following:

1) Self-harvest or harvest by family
2) Grocery stores
3) Other
    - Friends who fish
    - Ceremonies
    - Distribution by the tribe
    - Other (list)

The "ceremonies" category included potlucks and the "other (list)" category included restaurants and any other sources respondents mentioned that were not already specifically listed. Information on sources of fish is presented as the sum of individual responses as well as the means for each source.

6.3.2.9 Fishing site locations

In order to provide a more detailed account of the origin of fish obtained by tribal fishers, participants were asked to identify the specific locations within Cook Inlet where they fish for particular species. Those participants who indicated that they fish for themselves or the tribe identified fishing sites on several maps provided to them by the interviewer. In addition, they listed the names and/or descriptions of these sites next to each fish species caught. However, the maps did not encompass all of the usual and accustomed fishing areas utilized by tribal members and some tribal members did not wish to disclose their fishing sites.

6.3.2.10 Ceremonial consumption of fish

To substantiate the cultural importance and prevalence of fish to tribal members, respondents were asked questions about their attendance at ceremonies (including tribal and non-tribal community events) and their consumption of fish at these events.

6.3.3 Non-fish subsistence foods

6.3.3.1 Non-fish species consumed

Respondents were asked consumption questions regarding eleven non-fish species: harbor seal, beluga whale, bidarkis (black leather chitons), limpets (China caps), mussels, butter clams, little neck clams (steamers), snails (periwinkles, hairy tritons), octopus, and sea birds. “Sea birds” included birds considered to be “sea ducks” such as eiders, scoters, golden eyes, etc.. These species were chosen because they are some of the most important non-fish marine resources traditionally harvested by tribal members. Questions regarding beluga and snails were not asked in the earlier versions of the questionnaire used for Seldovia tribal members. It should be noted that crab was once a very important local food source for tribal members, as well, but due to large declines in their local population, they are no longer commonly harvested in the area.

6.3.3.2 Consumption throughout year

For each non-fish marine species listed above, respondents were asked how often they consume each species in a year. For each species, they were also asked either how many they consumed in a meal or in a year. Questions were phrased this way because many of these species are only eaten a very limited number of times in a year by tribal members. There were several additional questions asked regarding harbor seal and beluga whale consumption. Respondents were asked what harbor seal/beluga whale parts they commonly eat (meat, ribs, intestines, liver, flippers, other) and how they are typically prepared (boiled, fried, other). Additionally, they were asked how much harbor seal and/or beluga meat (or parts) they ate per meal. There were several choices they could pick from to answer this question: less than half a

plate, half a plate, a full plate, or more than one full plate. A “plate” was stated as being about the size of a regular dinner plate. Since “blubber/fat” was not listed in the earlier version of the questionnaire given to Seldovia tribal members for harbor seal, for analysis purposes, when respondents listed “oil” under “other parts,” they were considered to have eaten blubber/fat (since these parts are rendered into oil).

6.4 Development of additional forms

In addition to the QAPP and the interview questionnaire, SVT developed several other documents for this assessment. These other documents included: a contact activity log sheet, an interviewer check list, a confidentiality statement, and a consent form for respondents to sign prior to participating in the interviews. All these forms were attached as appendices to the QAPP and approved by EPA. The purpose of these forms were to insure quality control and to fully inform and clarify to respondents about the purpose of the assessment, expectations, how the data they provide would be protected and used, and how confidentiality would be maintained.

6.5 Data collection procedure

Interviewers were instructed to make at least four attempts to contact an individual by phone to schedule an interview. For those tribal members who did not have phones, interviewers were encouraged to try to reach these tribal members either by letter or in-person. On contact activity sheets, the interviewer logged his/her attempts to contact a tribal member. Additionally, these sheets were designed to allow the interviewer to make two changes to the original appointment in case rescheduling was necessary. Reasons were provided by the interviewer as to why an individual could not be interviewed (refused to participate, could not be contacted, etc.). A total of 76 interviews were completed between November 2011 and September 2012. Interviews were conducted either within central locations or at the homes of tribal members in each village.

6.6 Quality assurance/quality control in assessment implementation

6.6.1 Quality Assurance Project Plan

A 44-page Quality Assurance Project Plan (QAPP) was developed for this assessment and approved by EPA in 2012. It outlined: 1) background and need for assessment, 2) primary study goal, 3) objectives, 4) project organization, 5) project schedule, 6) target population, 7) statistical analysis, 8) quality control for interviewing, 9) quality control for data entry, management, storage, and analysis, 10) quality control for confidentiality, and 11) final report as well as including a reference page and appendices (copies of all the documents developed for the assessment). SVT staff and village interviewers conducted the assessment following the methods and procedures outlined in the QAPP.

6.6.2 Pretest

Interview pretests were conducted prior to the interviews actually being conducted. Tribal staff members were chosen and interviewed to determine the time required to administer the questionnaires and to identify potential problems with interpretation or delivery of questions.

6.6.3 Interviewer training

Before conducting interviews, key project staff reviewed EPA's Guidance for conducting fish and wildlife consumption surveys and Survey Management Handbook as well as several documents that discuss proper interviewing techniques. A training session for interviewers was hosted by SVT personnel through a teleconference call and webinar (a *join.me* session). Through these resources, project staff learned about obtaining accurate survey data, prevention of bias in responses to questions, use of food models to assist respondents in determining amounts of food consumed, and quality control.

6.6.4 Activities and efforts to maintain and improve accuracy of data

6.6.4.1 Presence of a monitor

In addition to the respondent and the interviewer, a designated quality control monitor was present during all interviews to observe and monitor the interview and to examine questionnaires for completeness. At the conclusion of an interview, if appropriate, the quality control monitor would suggest improvements to the interviewer. Additionally, if needed, the quality control monitor would assist with rephrasing or clarifying questions to respondents.

6.6.4.2 Use of digital voice recorders

After being read a confidentiality statement at the beginning of the interview, respondents were asked to sign a consent form agreeing to participate in the interview. Additionally, respondents checked a box on the consent form indicating whether they agreed, or did not agree, to have the interview recorded. For those respondents who agreed to have their interviews recorded, the interviews were recorded using digital voice recorders (ZOOM H2 Handy Recorder). The interviews were recorded so that responses to questions could be verified and clarified.

6.6.4.3 Use of food models

Plastic food models (fakefoodonline.com) approximating 3 and 5 ounce fish fillets were provided to aid respondents in estimating amounts of fish consumed.

6.6.4.4 Use of fish ID books

A fish identification book, A field guide to common marine fishes and invertebrates of Alaska by Susan C. Byersdorfer and Leslie J. Watson (2010), was made available to respondents during the interviews if they were unfamiliar with the name of a fish species. The identification book contained color photographs of fish species along with physical and life history descriptions. Often local names are used for fish species in the Cook Inlet Villages. For instance, “humpies” are pink salmon, “reds” are sockeye salmon, “kings” are chinook salmon, “dogs” are chum salmon, “silvers” are coho salmon, and “sablefish” is black cod. For this reason, respondents would sometimes not be able to recognize a fish species based on the name on the questionnaire form but would when shown a picture of it or the quality control monitor used the more common name known in the villages.

6.6.4.5 Reading questions and documents as written

A confidentiality statement, a consent form, and questions on the questionnaire were read “as written” to respondents by the interviewer. After being read a question, if the respondent was unclear about what was being asked, the question was then rephrased or clarified to them.

6.7 Procedures for protecting confidentiality

A confidentiality statement was read (as written) to respondents at the beginning of interviews explaining to them how the data would be used and how their identities would be protected. Participants were only identified by a number system on the contact activity log sheets and in the spreadsheet where their information was entered. No personal statements made by respondents which could identify them were entered into the spreadsheet. On the interviewer check list, the associated interview/questionnaire was only referenced by a number system. Completed questionnaires and the digital tape recorders were kept in secured offices.

6.8 Data processing

6.8.1 Data entry

Assessment data was entered into a Microsoft Excel spreadsheet maintained by SVT environmental department staff. If the respondent provided a range regarding their estimated fish consumption, the average of the high and low values was entered into the spreadsheet. Participants, and data subsequently referenced to them, were only identified by numbers in the spreadsheet.

6.8.2 Data analysis

To obtain the most accurate estimated mean rate of consumption for all respondents, the consumption rate for each respondent in grams per day was determined from the data on serving size and weekly fish consumption collected in the survey. This calculation was as follows:

Ounces eaten per meal x number of meals per week = ounces per week
Ounces per week/7 days per week = ounces per day
Ounces per day x 28.35 grams per ounce = grams per day (g/d)

In cases where the response was given as meals/month, the calculation was as follows:
ounces x meals/month = ounces per month
ounces per month/30.4 days per month = ounces per day
ounces per day x 28.35 grams/ounce = grams per day

Once the consumption rate for each respondent was calculated in grams per day (g/d), the average of these individual rates was calculated. The reported mean consumption rate estimate also includes those respondents that were not fish consumers and thus represents the estimated consumption rate of the entire tribal population sampled. Responses to questions concerning the number of fish-meals consumed by adults each month and the number of ounces consumed by adults at each meal were analyzed to determine if a correlation existed between these parameters.

Additionally, age and gender demographics as well as fish consumption rates and patterns for adults and children were compared with data collected from the Columbia River Basin tribes during their fish consumption survey (Columbia River Inter-Tribal Fish Commission 1994) to determine if, and what, differences existed between Cook Inlet tribes in Alaska and tribes in the lower 48 states who consume similar subsistence foods. Since SVT followed their methodology and utilized very similar questionnaire forms in this assessment, it was most appropriate to compare our data to their's.
There is also very little data currently available on fish consumption for tribes, in general, in which data collected in this assessment could be compared to.

6.8.3 Statistical tests

Since the sample size was less than 2000, a Shapiro-Wilk test was used to evaluate the normality of the untransformed data (grams/day for all respondents (fish consumers and non-fish consumers combined)) using the statistical software program, *R*. The resulting W statistic is the ratio of the best estimator of the variance (based on the square of a linear combination of the order statistics) to the usual corrected sum of squares estimator of the variance. W must be greater than zero and less than or equal to one, with small values of W leading to rejection of the null hypothesis. The Shapiro-Wilk statistic is very sensitive to deviations from normality (Columbia River Inter-Tribal Fish Commission 1994). Since the grams/day data, overall, was

not normally distributed and because of small sample sizes, non-parametric tests were used to compare data between groups (fishers vs. non-fishers, males vs. females, etc.). Two-tailed Mann-Whitney U tests were used to compare the medians/distributions between two groups since approximation is good for sample sizes above 20, sample sizes do not need to be equal, and no assumptions are made regarding normality of data (Choudhury 2009). Mann-Whitney U tests were performed using the online calculation available at http://elegans.som.vcu.edu/~leon/stats/utest.html. Using the online calculation available at http://www.vassarstats.net/kw3.html, a Kruskal-Wallis test was used to compare age groups (since there were more than two groups being compared) and a fisher exact test (using a 3 by 4 contingency table) was used to determine if differences existed in age distributions of participants among villages (since there were more than two groups and values within the samples were all below 10). Fisher's exact tests are good for small sample sizes and small values (McDonald 2009). For all statistical analyses, the alpha level was 0.05. For means, standard errors (SE) were calculated.

6.8.4 Outliers

Due to the small sample sizes, no values were excluded from analysis.

7. ASSESSMENT RESULTS

7.1 Demographic information

7.1.1 Sex of respondents

Overall, an equal number of females and males participated in the assessment (n_1 = 38 females, n_2 = 38 males; Figure 2, Table 1). In Seldovia and Nanwalek, a larger number of females participated than males in the interviews while more males participated in Port Graham and Tyonek (Figure 2, Table 1). The largest difference between the number of participating males and females occurred in Port Graham, with a difference of 5.

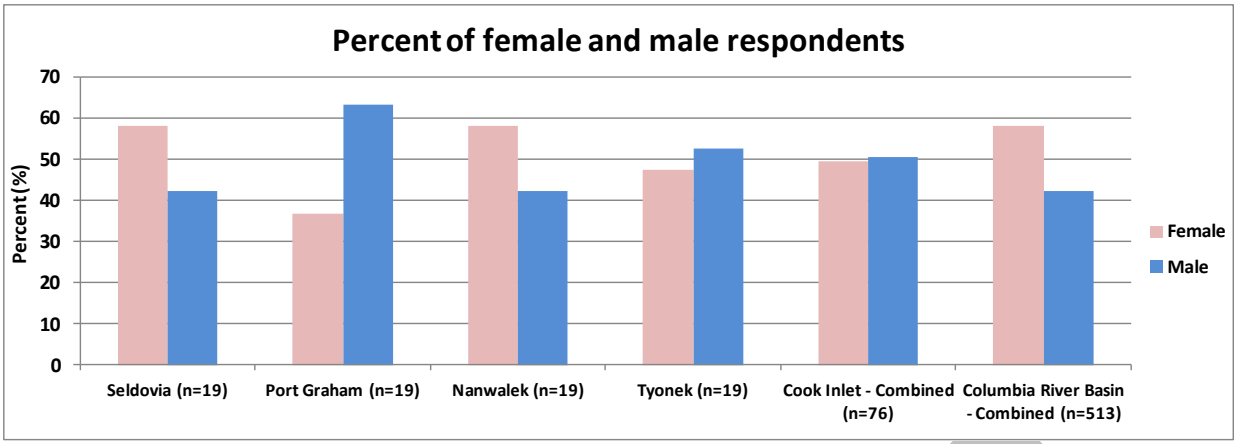

Figure 2. Percent of female and male respondents. Combined data is weighted.

Table 1. Number of female and male respondents per village.

Village	# of females	# of males
Seldovia	11	8
Port Graham	7	12
Nanwalek	11	8
Tyonek	9	10
Cook Inlet (combined)	38	38

7.1.2 Age of respondents

Overall, the average age of respondents (n=76) was 46.8 (± 2.33 SE) years. The average ages of respondents were 58.5 (± 2.85 SE), 52.8 (± 4.14 SE), 41.9 (± 2.94 SE), and 41.4 (± 3.08 SE), respectively, for Seldovia, Port Graham, Tyonek, and Nanwalek (n=19 for each village). The majority of respondents were between the ages of 40-59 years (Figure 3, Table 2).

Table 2. Number of respondents within age class and associated weighted percents.

Age group (Years)	Count	Weighted Percent (%)
18-39	24	35.9
40-59	30	40.4
60+	22	23.7

A Fisher's exact test revealed there were marginally significant differences (p = 0.046, FET, n=19 for each village) in the age distributions of respondents among villages. Nanwalek and Tyonek had a larger number of respondents between the ages of 18-49 (14/19 or 73.7% for each village) compared to 26.3% (5/19) for Seldovia and 36.8% (7/19) for Port Graham (Figure 3).

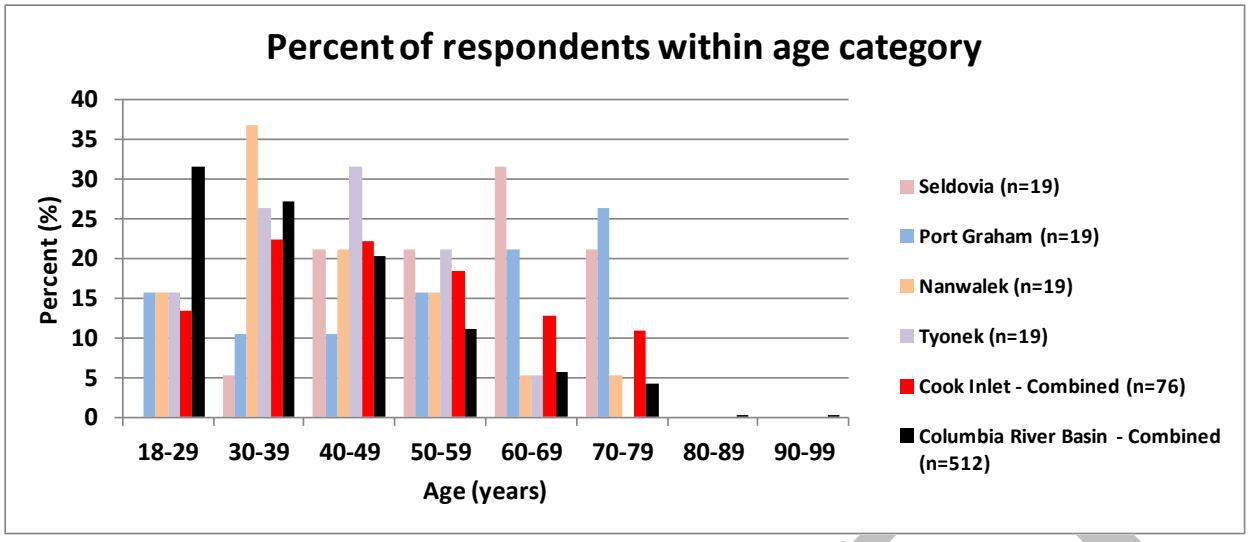

Figure 3. Percent of respondents within age category. Combined data is weighted.

7.2 Rates of adult fish consumption

The average rate of consumption by all interviewed adults (n=76) throughout the year for all species from all sources was determined to be 94.8 (± 23.55 SE) grams per day (g/d) (Figure 4). A Shapiro-Wilk normality test revealed that these data (g/d) were not normally distributed ($W = 0.482$, p-value < .0001). The majority of respondents indicated they ate up to 10 ounces of fish per fish-meal (69/76 or 91.0%). The remaining percent (9.0% or 7/76) of respondents indicated they ate more than 10 ounces. The mean of individual estimates of an average serving of fish was 7.06 (± 0.51 SE) ounces. Surprisingly, the standard deviation calculated from the g/d data was higher than what we originally anticipated when calculating the sample size needed for the assessment.

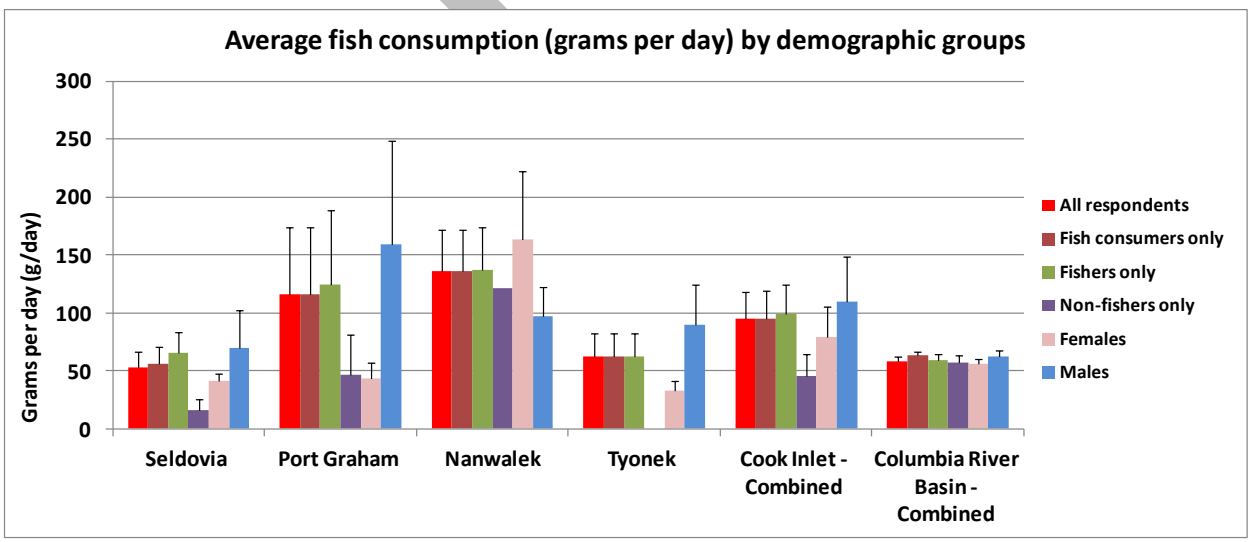

Figure 4. Average fish consumption (grams per day) ± SE by demographic groups. N values for categories: All respondents (n=19) for each Cook Inlet village; fish consumers only (n=18 for Seldovia, n=19 for all other Cook Inlet villages); fishers only (n=14 for Seldovia, n=17 for Port Graham, n=18 for Nanwalek, and n=19 for Tyonek);

non-fishers only (n=5, n=2 for Port Graham, n=1 for Nanwalek, and n=0 for Tyonek); females (n=11 for Seldovia, n=7 for Port Graham, n=11 for Nanwalek, and n=9 for Tyonek); males (n=8 for Seldovia, n=12 for Port Graham, n=8 for Nanwalek, and n=10 for Tyonek). N values for Columbia River Basin Tribes (combined): n=500 for all respondents, n=464 for fish consumers only, n=253 for fishers only, n=245 for non-fishers only, n=278 for females, and n=222 for males. Combined Cook Inlet data is weighted.

7.2.1 Rates of consumption for demographic categories

7.2.1.1 Fish-consumers vs. non-fish consumers

Four of 76 respondents indicated they rarely/never eat fish. However, in three of the four cases, the respondents indicated they ate fish at least once or twice a year and so the average number of fish-meals eaten by them weekly throughout the year was calculated by dividing the number of fish-meals they ate in a year by the number of weeks in a year (52.14 weeks). Reasons given that they no longer ate fish frequently included that they were no longer physically able to fish for themselves and that they had developed allergies to fish and other seafood. Excluding the individual that indicated they were not a fish consumer at all, interviewed fish consumers (n=75) consumed an average of 95.5 (± 23.83 SE) g/d of fish (Figure 4).

7.2.1.2 Fishers vs. non-fishers

Approximately 92% (92.1% or 68/76) of tribal members interviewed caught fish for personal consumption. Interestingly, the mean fish consumption rate for non-fishers (n=8) at 16.4 (± 9.85 SE) g/d was much lower than the mean consumption rate for fishers (n=68) at 66.1 (± 17.47 SE) g/d (Figure 4). A two-tailed Mann-Whitney U test revealed significant differences in the median g/d values between the two groups ($U = 421.5$, $p < 0.01$, $z = 2.53$, $n_1 = 68$, $n_2 = 8$).

7.2.1.3 Gender and age

Males consumed more fish than females (with males averaging 109.47 (± 39.18 SE) g/d and females averaging 79.75 (± 26.32 SE) g/d (Figure 4). However, a two-tailed Mann-Whitney U test revealed no significant differences between the median g/d values between males and females ($U = 816.5$, $p \geq 0.05$, $n_1 = 38$, $n_2 = 38$). Respondents between the ages of 40 and 59 years consumed, on average, 109.6 (± 48.91 SE) g/d of fish, which was more fish than any other age group (18-39, 60+). Interestingly, the age group having the second largest fish consumption rate was respondents between the ages of 18-39 years with an average rate of 105.8 (± 41.67 SE) g/d (Figure 5). No significant differences between age groups (statistic $H = 2.79$, $df = 2$, $p = 0.2478$, $n_1 = 24$, $n_2 = 30$, $n_3 = 22$) were detected with a Kruskal-Wallis test.

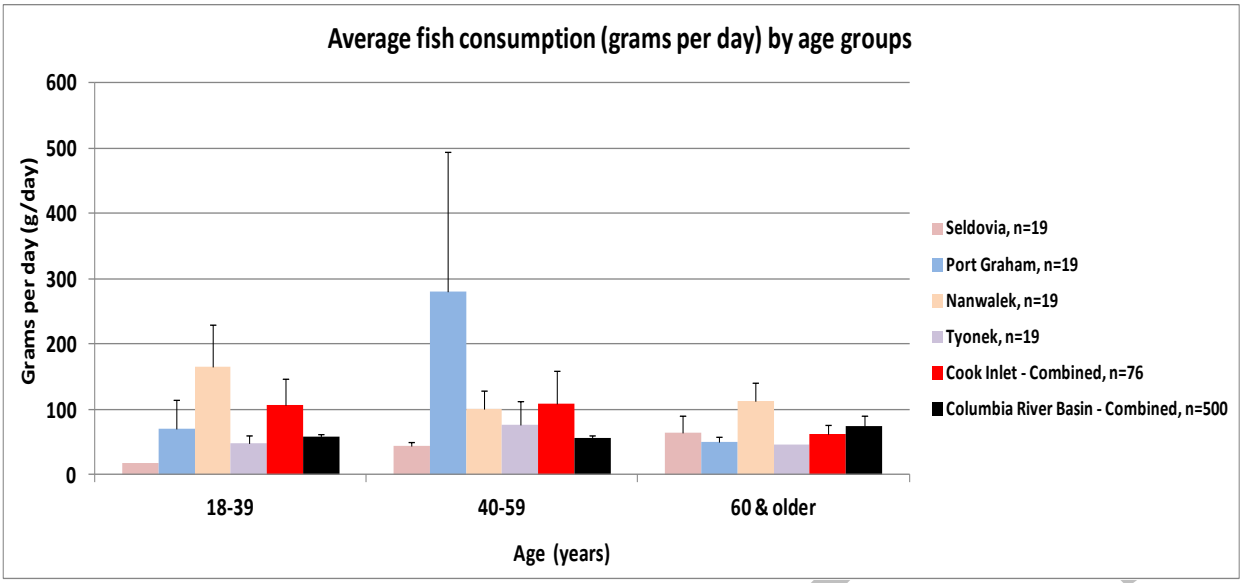

Figure 5. Average fish consumption (grams per day) ± SE by age groups. Combined data is weighted.

7.2.2 Seasonal rate of fish consumption

For approximately 52 percent (51.9% or 40/76) of respondents, the two months of highest fish consumption were June and July or July and August. For all months identified as high fish consumption months by the entire population sampled (i.e., fish consumers and non-fish consumers combined) respondents consumed an average of 116.4 (± 19.34 SE) g/d of fish (n=75). Additionally, out of the four villages, tribal members of Nanwalek consumed the most fish, on average, during high fish consumption months at 189.6 (± 37.57 SE) g/d (Figures 6 and 7).

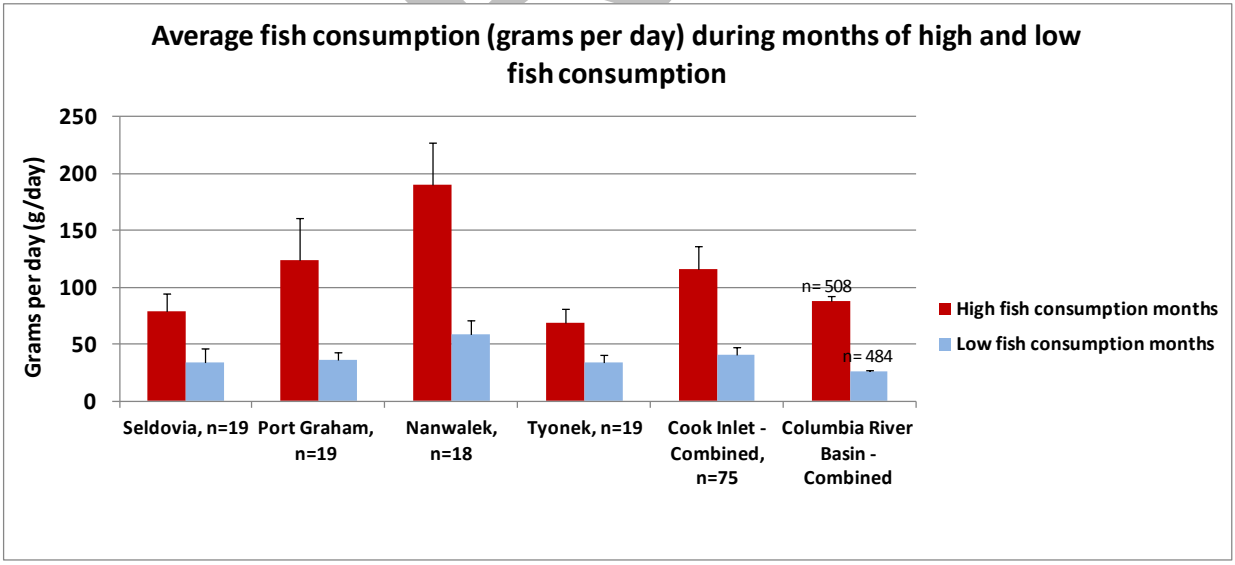

Figure 6. Average fish consumption (grams per day) ± SE during months of high and low fish consumption. Combined data is weighted. Per individual Cook Inlet village, sample sizes (n) for both high and low fish consumption months are identical.

When asked about the months of lowest fish consumption, approximately 63 percent (63.2% or 47/76) of respondents indicated that they ate the least fish during the months of November through May with January being cited the most frequently as a month of least fish consumption (16/76 or 20.8%). During all low-fish consumption months as identified by the entire population sampled, respondents consumed an average of 41.0 g/d (± 6.44 SE)(Figure 6). Tribal members of Tyonek and Seldovia (n=19 for both villages) consumed the least amount of fish during these months. In fact, respondents from both villages, on average, consumed an equally low amount of fish during this time period at 33.6 g/d (± 12.75 and ± 6.93 SE for Seldovia and Tyonek, respectively). Overall, the mean rate of consumption in high fish consumption months was nearly 3 times higher than the mean rate of consumption in low fish consumption months (Figures 6 and 7).

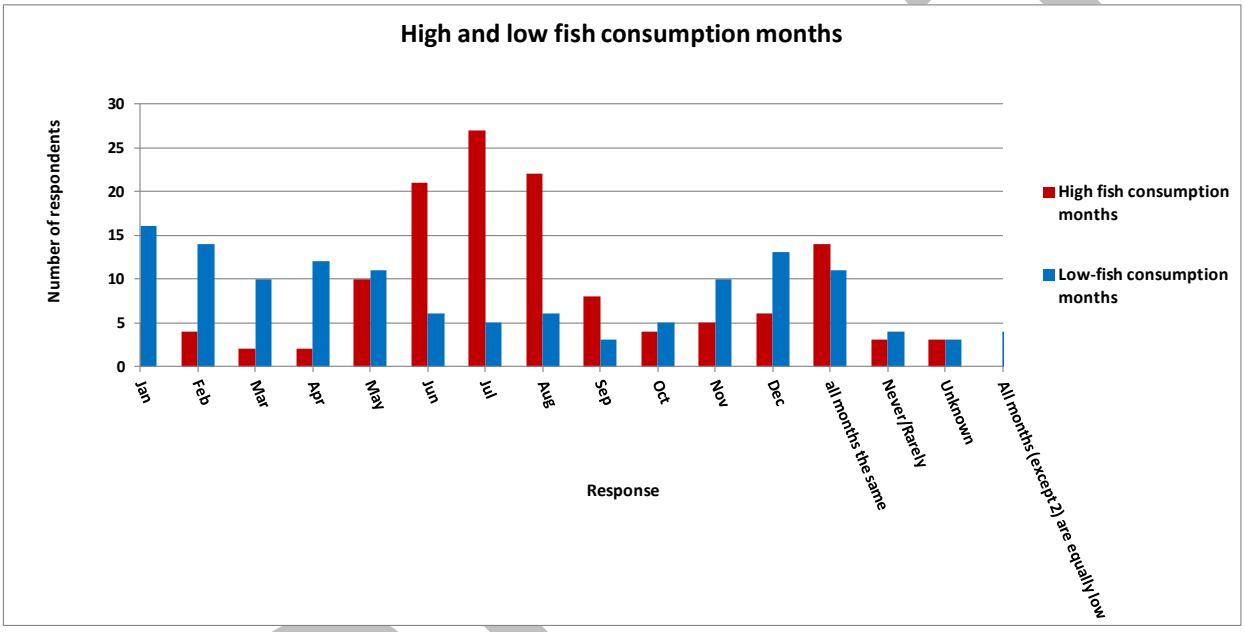

Figure 7. High and low fish consumption months. Unweighted data.

7.2.3 Dietary recall

Approximately 40 percent (40.5% or 31/76) of respondents indicated they had eaten fish within the 24 hours preceding the survey interview; 59.5 percent or 45/76 of respondents had not consumed fish during this period. The overall rate of consumption reported by respondents who had consumed fish in the 24 hours preceding the interview was compared to the overall rate of consumption reported by respondents who had not consumed fish during that period. A two-tailed Mann-Whitney U test ($U = 1007.5$, $p < 0.01$, $n_1 = 44$, $n_2 = 32$) revealed that respondents who had eaten fish within this time frame, on average, had significantly different median fish consumption rates (g/d) than those who had not eaten fish. The average fish consumption rate for respondents who had eaten fish (112.80 (± 30.78 SE) g/d) within the 24 hours prior to their interviews (n=31) was higher than for those who had not (81.76 (± 34.02 SE) g/d; n=45).

7.2.4 Women who have nursed or currently are nursing

Of the 37 women who responded to the question regarding whether they had ever give birth, 96.3% or 36/37 said they had given birth. Out of those women who had given birth, approximately 68 percent (68.0% or 25/35, n=35) said they had breast fed their youngest child. No interviewed female was currently breast-feeding. Of those children who were breast fed (n=25), the average age that the children stopped breast-feeding was 11.48 (± 2.31 SE) months. Women who breast-fed, consumed on average, 100.05 (± 38.52 SE) g/d which is higher than the mean fish consumption rate found, in general, for women (79.75 (± 26.32 SE) g/d) within the tribal population. A two-tailed Mann-Whitney U test ($U = 158.5$, $p \geq 0.05$, $n_1 = 25$, $n_2 = 11$) revealed no significant differences in median g/d between women who breast-fed and women who did not.

7.2.5 Consumption of different species by adults

Overall, coho salmon was the fish species eaten by the most respondents (89.5% or 66/75 of respondents), followed by halibut (83.9% or 64/75 of respondents), chinook salmon (79.0% or 59/75 respondents), sockeye salmon (75.4% or 59/75 of respondents), and pink salmon (63.8% or 50/75 of respondents) (Figure 8). In terms of quantity (g/d), though, sockeye salmon had the highest average daily consumption rate by respondents at 41.9 (± 26.18 SE) g/d followed by coho salmon at 31.8 (± 9.66 SE) g/d then pink salmon at 23.4 (± 9.64 SE). It should be also noted that among villages, there was considerable variation in which species contributed to the highest percentages (based on total grams consumed by respondents per month) of fish consumption (Figures 9-12). For instance, in Seldovia, sockeye salmon and halibut made up the majority of fish consumed while in Port Graham, it was sockeye and pink salmon. In Nanwalek, the highest percentages of fish consumed were coho and pink salmon, while it was chinook and coho salmon in Tyonek (Figures 9-12).

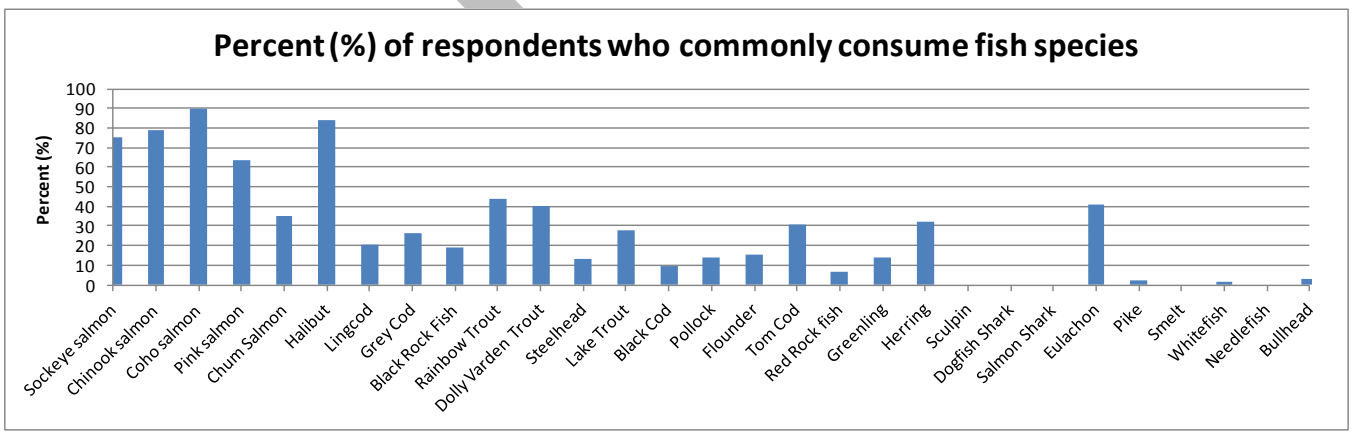

Figure 8. Percent (%) of respondents (n=76) who commonly consume fish species. Weighted data. Seldovia data not included in this graph for the following species: pike, smelt, whitefish, needlefish, and bullhead since they were not included in original questionnaire.

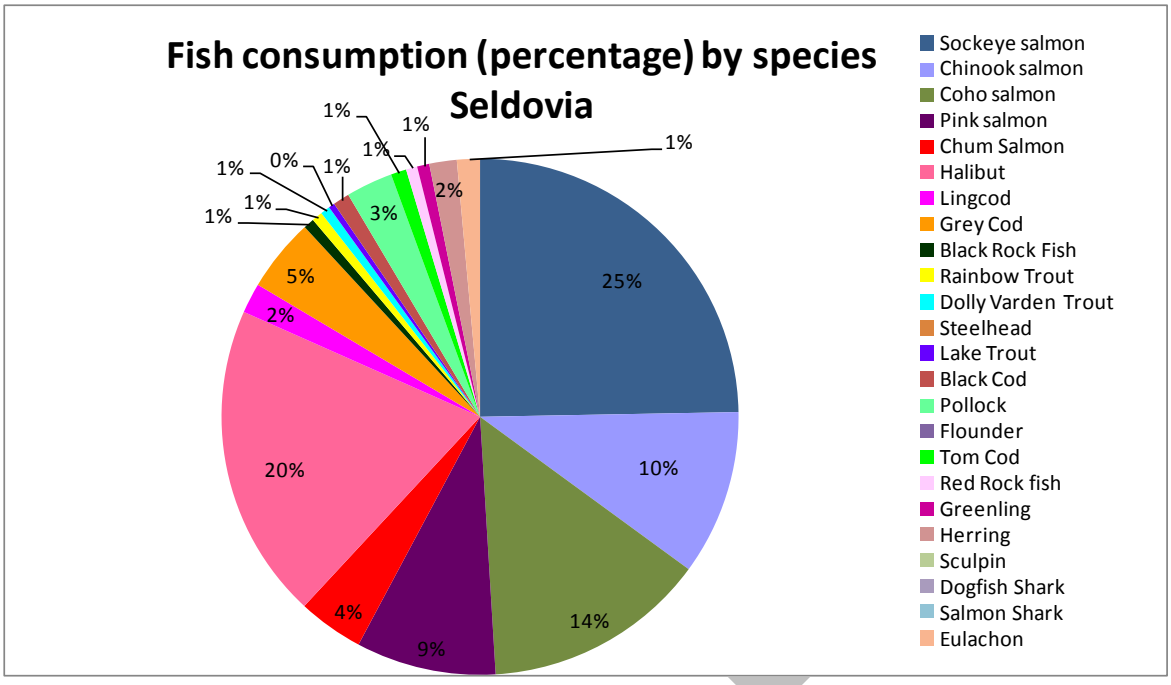

Figure 9. Fish consumption (percentage) by species for Seldovia. Unweighted data. Percentages based on grams consumed per month as calculated by number of monthly fish-meals of species, and average serving size of fish, reported by respondents (n=19).

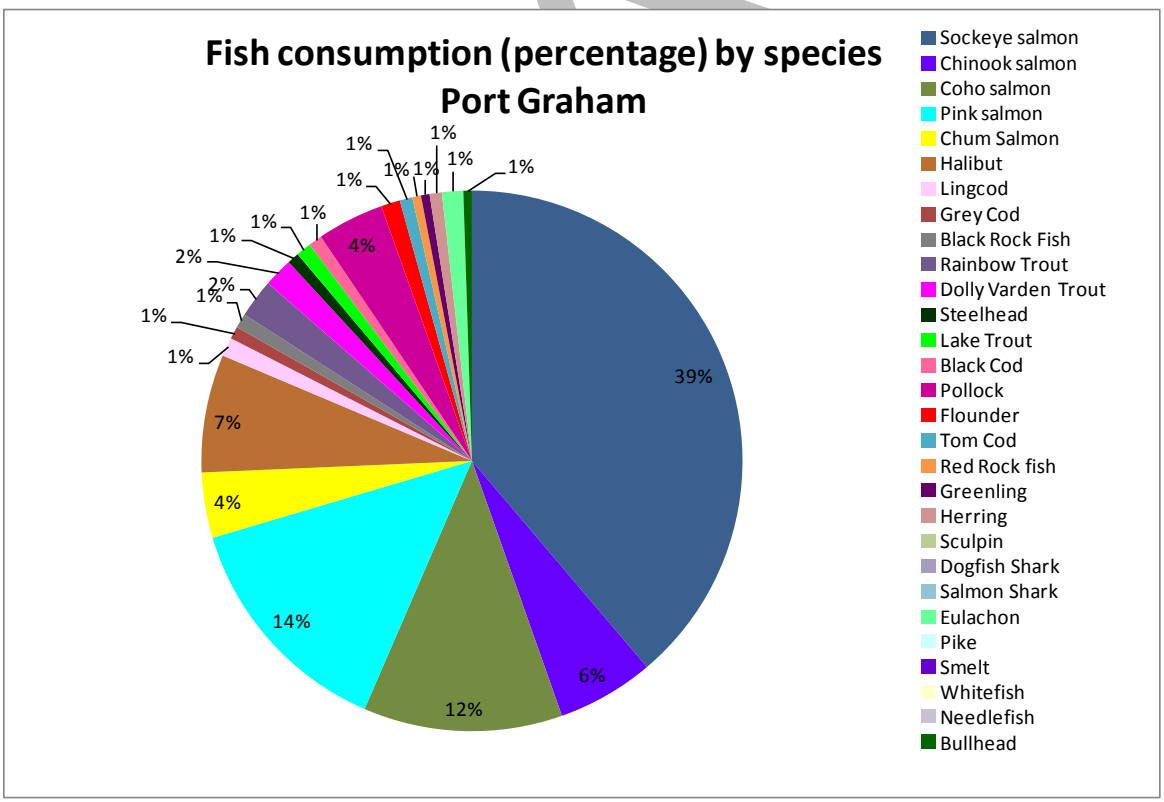

Figure 10. Fish consumption (percentage) by species for Port Graham. Unweighted data. Percentages based on grams consumed per month as calculated by number of monthly fish-meals of species, and average serving size of fish, reported by respondents (n=19).

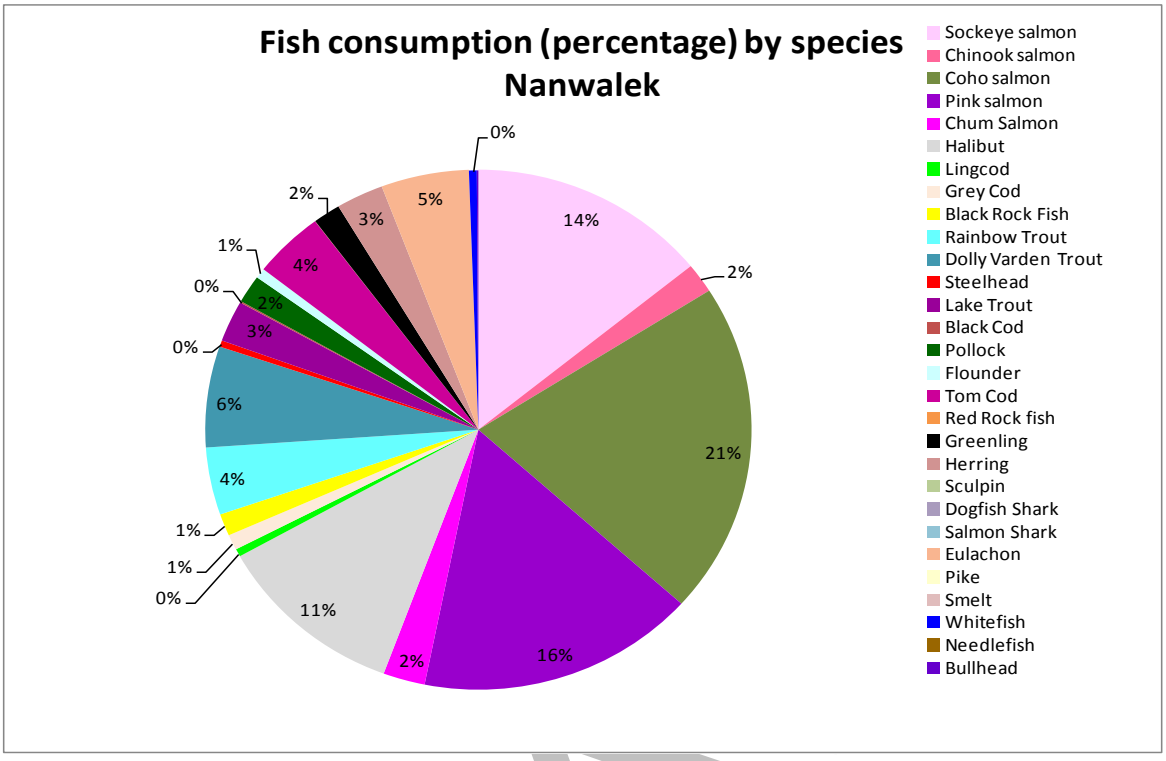

Figure 11. Fish consumption (percentage) by species for Nanwalek. Unweighted data. Percentages based on grams consumed per month as calculated by number of monthly fish-meals of species, and average serving size of fish, reported by respondents (n=19).

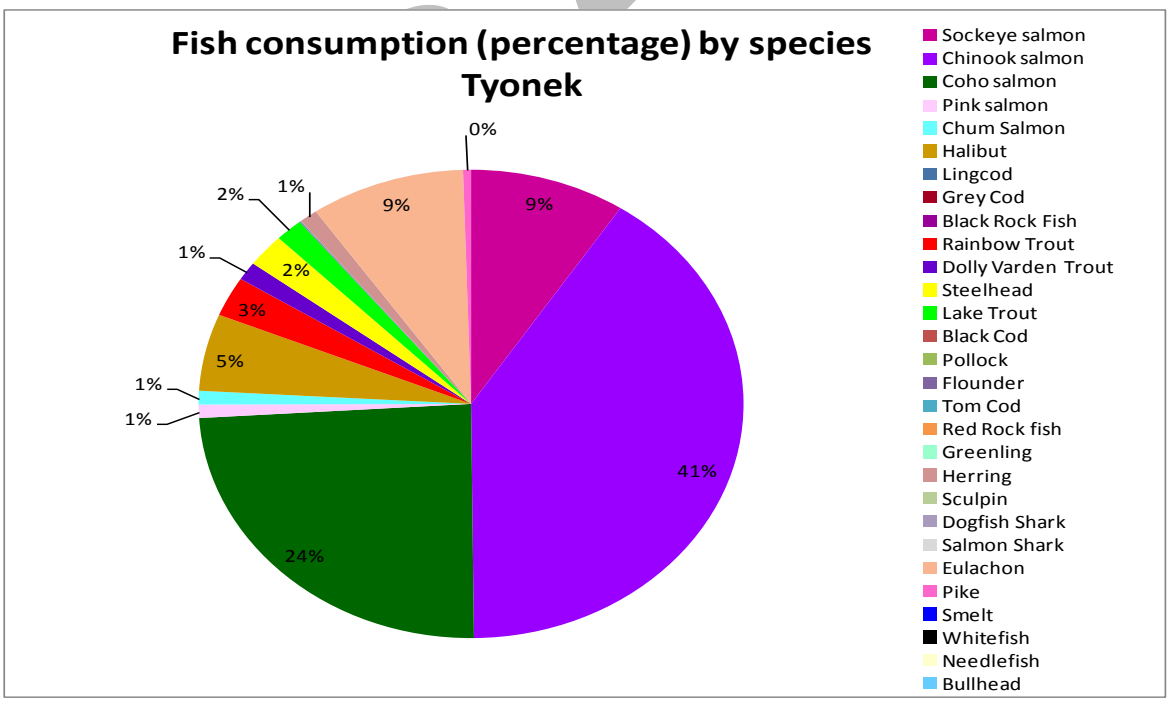

Figure 12. Fish consumption (percentage) by species for Tyonek. Unweighted data. Percentages based on grams consumed per month as calculated by number of monthly fish-meals of species, and average serving size of fish, reported by respondents (n=19).

7.2.6 Consumption of specific parts by adults

Respondents indicated that they consumed the following fish parts: fillet, skin, head, eggs, bones, belly flaps/meat, and other organs. For each village, fillets were the most popular fish part eaten by respondents (Figures 13-16). Skin, eggs, and belly flaps/meat were also consumed frequently.

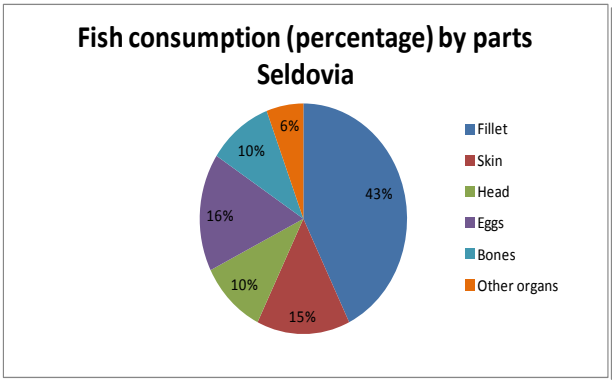

Figure 13. Fish consumption (percentage) by parts for Seldovia (n=19). Unweighted data. Percentages based on total counts of responses, across all fish species, indicating parts are eaten.

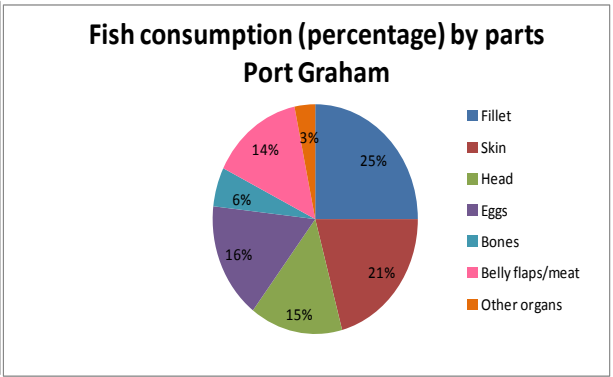

Figure 14. Fish consumption (percentage) by parts for Port Graham (n=19). Unweighted data. Percentages based on total counts of responses, across all fish species, indicating parts are eaten.

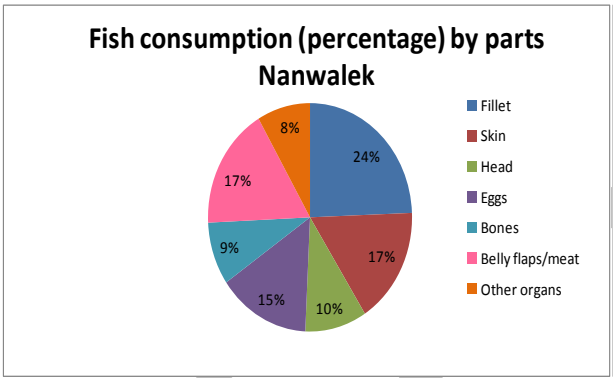

Figure 15. Fish consumption (percentage) by parts for Nanwalek (n=19). Unweighted data. Percentages based on total counts of responses, across all fish species, indicating parts are eaten.

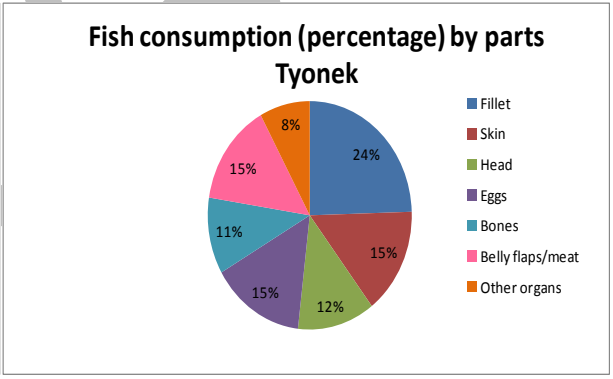

Figure 16. Fish consumption (percentage) by parts for Tyonek (n=19). Unweighted data. Percentages based on total counts of responses, across all fish species, indicating parts are eaten.

7.3 Fish preparation methods

Of all respondents, 73.6% (58/76) regularly prepare the meals in their households. The most popular cooking/preparation methods for fish-meals (in order of popularity) were smoked, pan-fried, canned, baked, and boiled. For each of these top cooking methods, the highest proportion of respondents indicated they cooked/ate fish these ways once a week or more: smoked (58.2% or 40/76), pan-fried (44.6% or 30/76), canned (47.4% or 35/76), baked (44.3% or 31/76), and boiled (35.3% or 26/76).

7.4 Origin of fish consumed

On average, 80.0% (15.10 SE) of all respondents (n=76) obtained their fish by personally harvesting the fish themselves and/or through family members, 9.5% (± 10.88 SE) from friends, 4.9% (± 4.95 SE) from ceremonies, 1.6% (± 2.36 SE) from grocery stores, 1.1% (± 3.09 SE) through distribution from the tribe, and 0.94% (± 3.86 SE) from other sources such as restaurants.

7.5 Fish harvesting

Approximately 92% percent (92.1% or 68/76) of respondents indicated they catch fish for personal consumption. All five salmon species, plus halibut, were the most common fish species harvested. For Seldovia, the most popular local fishing spots were Tutka Bay, Hoen's Lagoon, the slough, off Barabara Point, off Point Pogibshi, Jakolof Bay, and Outside Beach. For Port Graham, the most popular fishing locations were Port Graham Bay, Passage Island, Nanwalek, Windy Bay, off Point Pogibshi, at the floats, and Outside Island. Favorite fishing spots of respondents from Nanwalek were at the end of the air strip, Nanwalek Bay, 1st lake and 1st hole, Dogfish Bay, by the Yum Yum tree, Humpy Creek, and Nanwalek Lagoon. Popular fishing locations indicated by respondents from Tyonek were Tyonek Beach, Old Tyonek Beach, Tyonek Village, Beshta Bay, Homer, the Chuitt River, and Nicolai River. Additionally, Flat Island, was commonly cited by Seldovia and Port Graham respondents. Of respondents who fish, 61.4% (44/74) indicated that they usually travel to fish between 0-5 miles, 12.7% (9/74) between 6-10 miles, 10.9% (10/74) between 11-15 miles, 12.1% (9/74) between 16 and 20 miles, and 3% (2/74) greater than 20 miles.

7.6 Ceremonial consumption of fish

7.6.1 Frequency of ceremony attendance

Roughly 90% (90.1% or 67/76) of respondents indicated they attend ceremonies or community events. While 45.2% (35/76) of tribal members indicated they attend ceremonies/community events less than once a month, 30.9% (22/76) indicated one to three times a month, 11.0%(8/76) four to six times a month, and 3.0% (2/76) greater than six times a month.

7.6.2 Frequency of fish consumed at ceremonies

Of respondents who indicated they attend ceremonies/community events, nearly 87% (86.9% or 58/67) consume fish at these occasions. Approximately 67% (66.6% or 38/67) of these respondents indicated they eat fish at nearly all these events, 16.1% (10/67) about half of the time, and 17.3% (10/67) eat fish less than half the time at these events.

7.6.3 Amount of fish consumption during tribal ceremonies

Of respondents who attend ceremonies/community events and eat fish at these events, approximately 71% (70.9% or 42/58) eat one to two 6-ounce servings at each ceremony. Nearly 24% (23.9% or 13/58) of these respondents indicated they eat three to four 6-ounce servings at such events, and five to six 6-ounce servings or more were eaten by 5.1% (3/58) of respondents.

7.7 Children

Information on fish consumption was obtained for 35 children (17 years of age or younger). A large proportion of these children (65.6% or 23/34) were male. The average age of these children was 6.2 (± 1.22 SE) years old.

7.7.1 Age when children begin eating fish

Of children who consumed fish (n=31), the average age they began eating meals that included fish was 11.8 (± 2.58 SE) months (n=30).

7.7.2 Children's consumption rates

Approximately 87 percent (86.9% or 31/35) of the children whom information was given, ate fish. The average rate of fish consumption for all children (including those who ate fish and those who didn't) was 78.2 (± 30.85 SE) g/d.

7.7.3 Consumption of different species by children

Not surprisingly, consumption patterns of children (whom information was given) were similar to adults. Coho salmon was the most popular fish species eaten by children (eaten by 81.4% or 28/35 of children) followed by sockeye salmon (eaten by 77.4% or 26/35 of children), halibut (76.8% or 27/33 of respondents), pink salmon (eaten by 63.7% or 21/33 of children), and chinook salmon (eaten by 57.8% or 21/33 of children) (Figure 17).

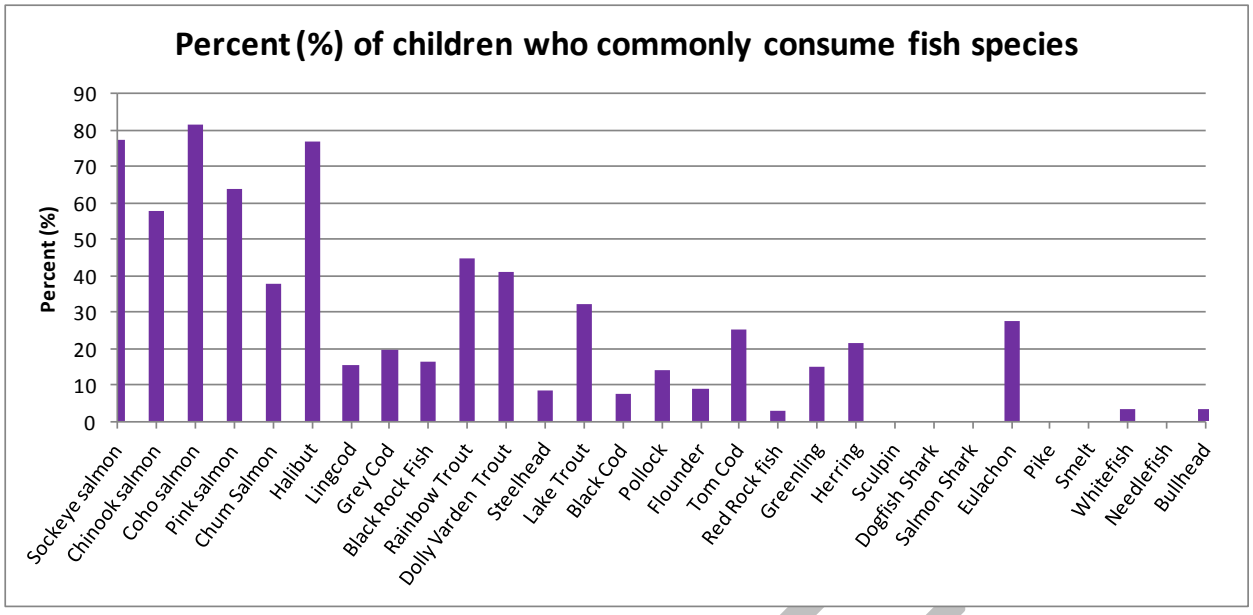

Figure 17. Percent (%) of children who commonly consume fish species. Weighted data. Seldovia data not included in this graph for the following species: pike, smelt, whitefish, needlefish, and bullhead since they were not included in original questionnaire.

7.7.4 Consumption of specific parts by children

As in the case of adults, fillets, eggs, and skin were consumed the most frequently by children (Figures 18-19). Respondents indicated that their children consumed fillet more frequently than any other fish part for all species.

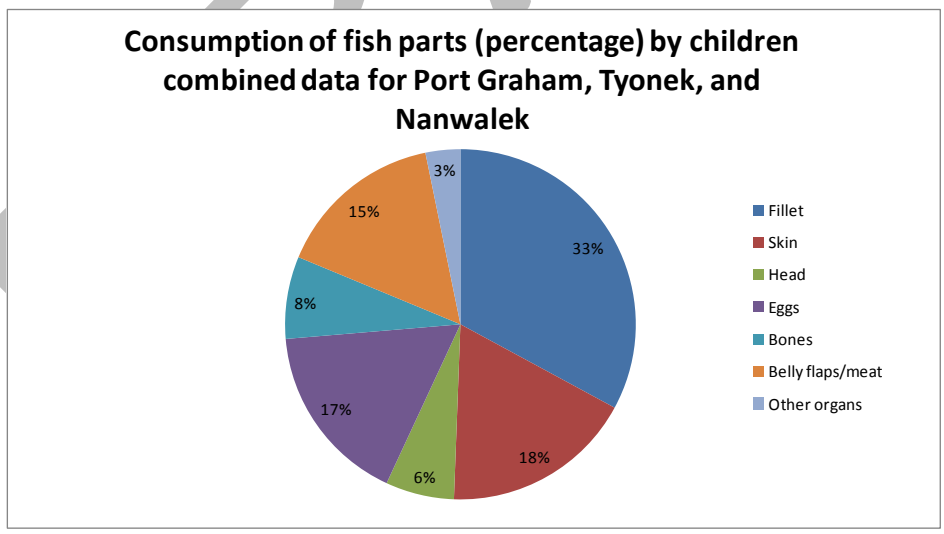

Figure 18. Fish consumption (percentage) by parts for Port Graham, Tyonek, and Nanwalek (n=31). Weighted data. Percentages based on total number of responses, across all fish species, indicating the parts that are eaten.

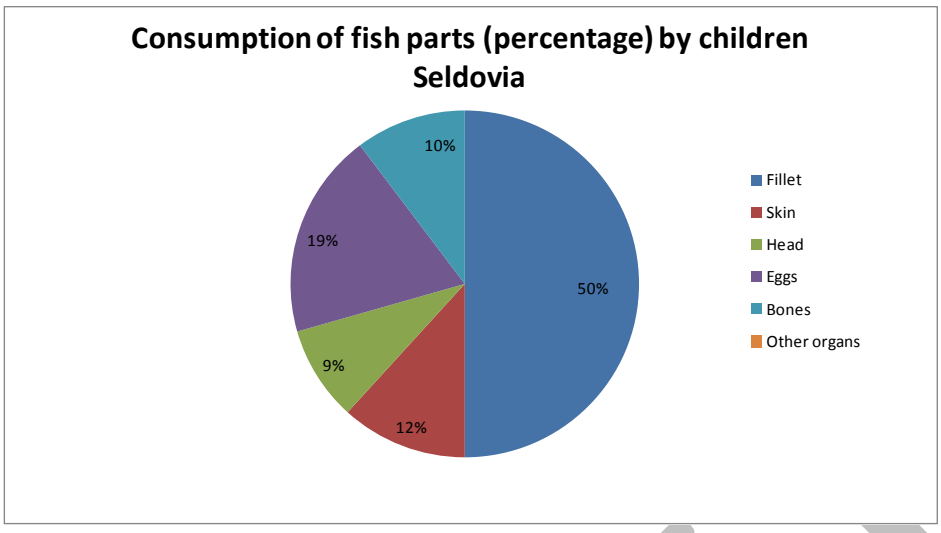

Figure 19. Fish consumption (percentage) by parts for Seldovia (n=4). Unweighted data. Percentages based on total counts of responses, across all fish species, indicating the parts that are eaten. Belly flaps/meat not included since this choice was not on original questionnaire.

7.8 Adult consumption of non-fish subsistence foods

Although respondents indicated that fish was by far the most consumed subsistence resource (being consumed by 99.2% or 75/76), other marine taxa/species were identified as being important food sources to adult tribal members through this assessment, especially clams, black leather chitons (bidarkis), octopus, and harbor seal (Figure 20). Approximately 60% (60.2% or 47/76) of respondents eat butter clams, 57.4% (47/76) eat bidarkis, 56.1% (45/76) eat octopus and 41.8% (34/76) consume little neck clams from harvested sources (not obtained from stores or restaurants). In addition, 47.8% (36/76) of respondents eat harbor seal. The meat, ribs, and blubber/fat were the most popular parts eaten from seals, (44.3% or 34/76, 39.7% or 30/76, and 36.6% or 27/76, respectively) (Figure 21). Of those who ate harbor seal, the most common ways to cook seal parts were boiling (which includes rendering it for oil, soup, gravy, etc.) and baking (baking made up the overwhelmingly majority of "other cooking methods" although roasting/singeing over open fire, fermenting, and pickling were also mentioned) (Figure 22). The majority (25.2% or 10/35) of respondents who eat harbor seal consume the equivalent of half a dinner plate full per meal while 23.4% (9/35) eat less than half a dinner plate full, 20.7% (10/35) eat a full dinner plate full, and 15.5% (6/35) eat more than one full dinner plate full.

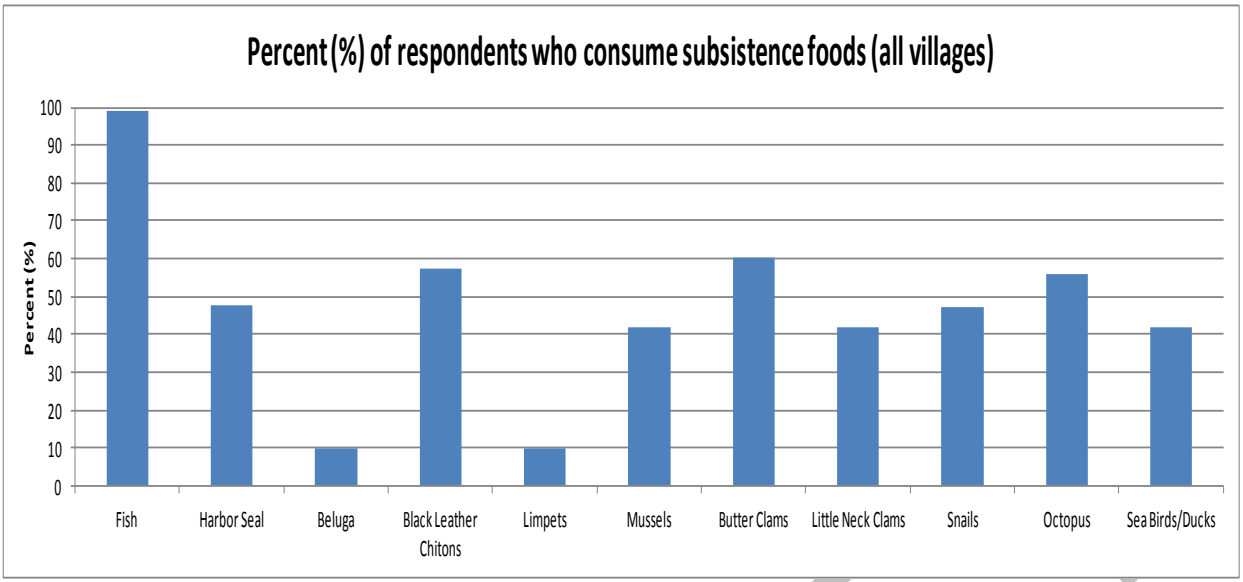

Figure 20. Percent (%) of respondents (n=76) who consume subsistence foods. Weighted data. Seldovia data not included for beluga (n=57) or snails (n=57) since they were not included in original questionnaire.

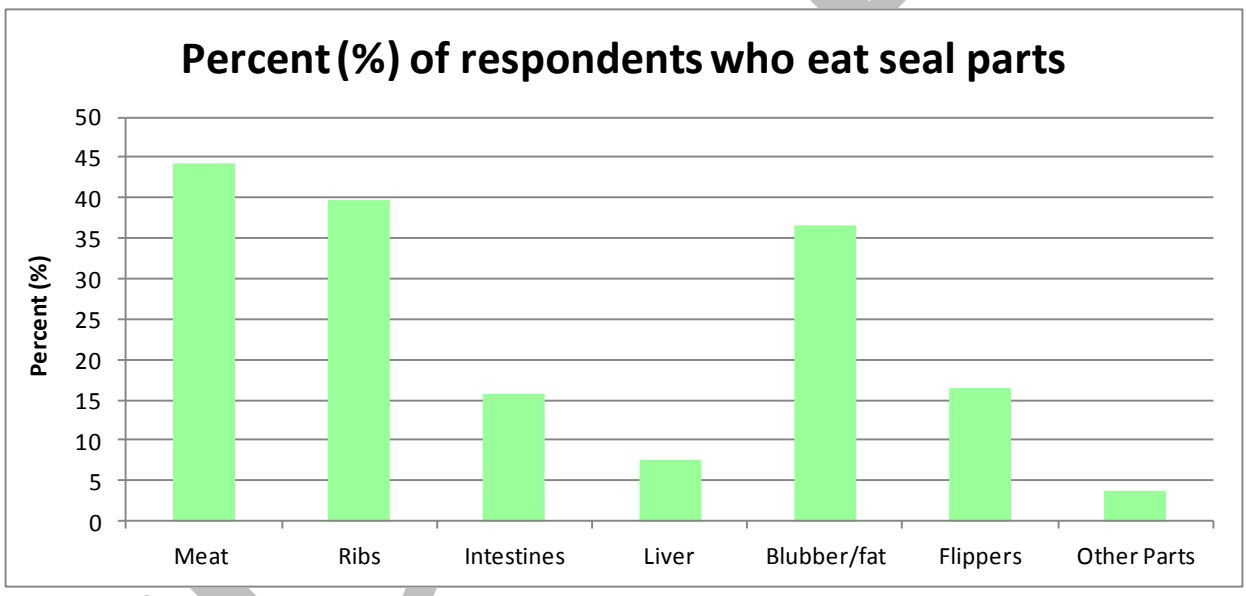

Figure 21. Consumption (percentage) of seal parts by respondents (n=76). Weighted data.

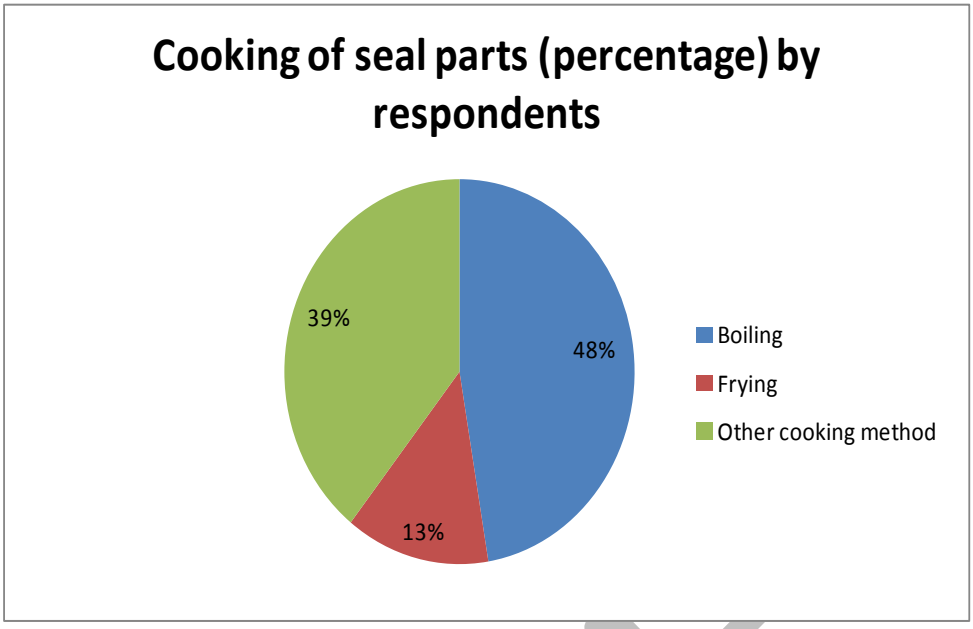

Figure 22. Cooking (percentage) of seal parts by respondents who eat seal (n=35). Weighted data. Percentages based on total counts of responses, across all seal parts, indicating parts are cooked that way.

For the villages of Port Graham, Nanwalek, and Tyonek, respondents were also asked questions regarding their consumption of beluga whales and snails. While only a small percentage of these respondents ate beluga whale (9.7% or 5/57), a fairly large proportion did eat snails (47.1% or 12/57) (Figure 20).

Unsurprisingly, those non-fish subsistence foods identified as being eaten by more respondents (more popular) (n=76) were eaten more often, on average, per month than less popular non-fish foods (Figure 23). Black leather chitons were eaten, on average, the most frequently per month at 0.88 (± 0.23 SE) times/month followed by butter clams at 0.31 (± 0.07 SE), harbor seal at 0.30 (±0.09), then octopus at 0.30 (± 0.07 SE).

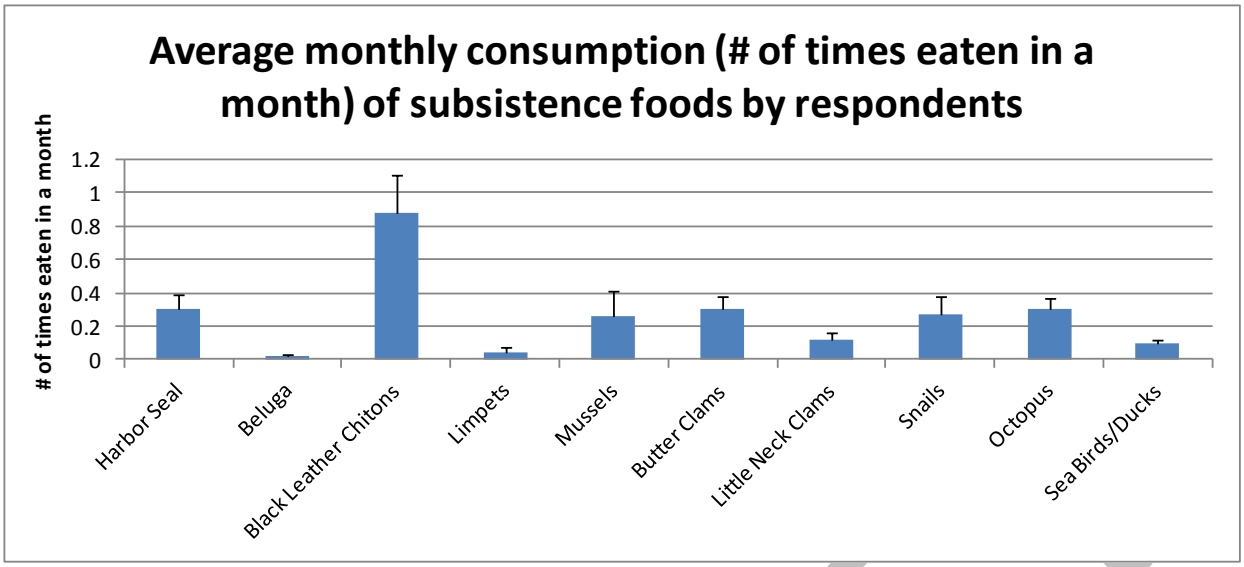

Figure 23. Average monthly consumption of subsistence foods ± SE by respondents (n=76). Weighted data. Seldovia data not included for snails (n=57) or beluga (n=57) since they were not included in original questionnaire.

8. DISCUSSION

8.1 Limitations of assessment

8.1.1 Categorization and classification of subsistence food items

Although the survey indicates highest and lowest consumption rates it does not establish a classification of subsistence food considered the highest and lowest sought after species or amounts which are used consistently by Alaska Natives in general within the community and intertribal for consumption and sharing meaning that all customary and traditional native food items are all equally important.

8.1.2 Low sample size and high variability

Seventy-six questionnaire forms, 19 from each village, is a small sample size and therefore when the data are analyzed into demographic groups or sub-categories (such as age categories, gender, etc.), sample sizes become very small with high variability (i.e. large standard errors). Consequently, it may have been difficult to determine statistically significant differences between results. A sample size of 19 was based on a population size of 34 households in Seldovia. This sample size was chosen not only because it was a realistic goal for Seldovia but also because it was calculated that the mean consumption for Seldovia's adult tribal members would be within a bound of 9 grams from the "true" mean with 95% confidence. However, there ended up being a standard error of approximately 14 grams for Seldovia. This may be due to larger variation in individual g/d rates for tribal members than the standard deviation of 30 g/d used initially in the sample size calculations based upon previous fish

consumption surveys/studies. Sample sizes of 19 were used in each participating village to be consistent.

8.1.3 Sampling bias

Although an equal number of adult males and females participated in this assessment, a much larger proportion of male, compared to female, children were represented in the dietary information collected. This may have influenced the overall fish consumption rate found for children since it would be expected that boys would consume larger amounts of food than girls.

8.1.4 Timing of survey and length of survey period

Conducting the assessment during periods of high or low fish consumption could have biased individuals' responses. It is possible that respondents indicated higher or lower consumption rates in accordance with when they were questioned about their consumption. Since this assessment was conducted between November 2011 and September 2012 (most surveys conducted in May 2012), consumption as reported by tribal members could be overestimated. Also, respondents may have under-reported consumption of fish species not in season at the time the assessment was conducted or over-reported fish species in season during the interview period.

8.1.5 Non-fish consumers

It is possible that some tribal members did not return phone calls or respond when contacted about the assessment because they thought that their contributions would be meaningless if they did not eat fish. Therefore, fish consumers may be slightly over-represented in the respondent pool thereby creating an overestimation of fish consumption rates.

8.1.6 Nursing/breast-feeding women

As mentioned previously, all female respondents who had given birth were asked how long they had breast-fed their youngest child for, regardless of when they had given birth. Therefore, there may be considerable memory recall error if a long time has passed since a respondent had given birth. This is particularly true for community members whose youngest "children" are now grown adults. Over long time frames, changing historical, scientific, and cultural factors could have influenced the breast- feeding time periods reported as well.

8.1.7 Children

Often respondents provided similar information for a child's consumption as they did for their own. Although it is certainly not unreasonable for a child to consume similar amounts of fish or to follow similar patterns of fish consumption as adults within the same household, it is

possible these responses were influenced by the convenience of indicating similar information. Any resulting bias in dietary information reported for children from this factor, though, would be difficult to determine in regards to overestimation or underestimation of fish consumption.

8.1.8 Dietary recall

Respondents who consumed fish during the 24 hours preceding the survey interview had higher overall consumption rates than those who did not eat fish during that period. This difference could be due to several factors. First, persons who recently consumed fish may have been more likely to overestimate the number of fish-meals they eat each week than those who had not consumed fish for several days or several weeks. However, on the other hand, individuals who ate fish recently may be more accurate in the data they provide concerning the number of ounces they eat in each meal. It is also possible that individuals who consume high amounts of fish throughout the year would have been more likely to have consumed fish during the 24 hours preceding the interview than individuals who consume less fish throughout the year. Thus, these individuals would not necessarily be overestimating their fish consumption.

8.1.9 Non-fish subsistence foods

Consumption of invertebrate species and other non-fish animals, in general, is difficult to quantify for tribal members. Often tribal members collect clams, bidarkis, and mussels in buckets when they harvest them but do not count or weigh them. Although it may be relatively easy for them to recall how many times they have eaten species, like octopus, within the past year, trying to quantify that in terms of ounces or lbs is much more difficult especially when they may be only eating a portion of the animal (such as the arms of the octopus) or the animal minced in a dish.

For this assessment, tribal members were asked about the number of times they ate these species in a year and about the number of individuals they typically ate in a meal or within a year since it was thought this might be easier for them to visualize than weights and subsequently be more accurate (this is especially true for bivalves). However, quantifying amounts eaten by respondents still proved a challenge. Answers were not given in consistent forms (sometimes quantities would be give as whole numbers, other times in “cups”, “pints”, “bucket fulls,” or “portions” of a whole animal). Collecting consumption data on these food sources is very difficult because these are not food sources typically thought of in quantity terms when being harvested, and they are not consumed as frequently as fish.

It should be noted that several respondents, especially from Nanwalek and Port Graham, remarked that they commonly eat sea lion, razor clams, and gumboot chitons as well. These were not on the questionnaire. The percent of respondents who eat snails and beluga (as well as how frequently they are eaten per month) may have been higher if those questions had been asked of Seldovia tribal members as well.

8.1.10 Different versions of questionnaire forms

At the time SVT was planning and organizing the assessment for Seldovia, it was not known whether this assessment would be conducted in other Cook Inlet Villages. Unfortunately, the assessment had already been conducted in Seldovia by the time it was known that other villages would be participating. Although minor, a few additional fish and invertebrate species as well as parts and cooking methods were added to the questionnaire form (used by Port Graham, Nanwalek, and Tyonek), that were not on the questionnaire form originally used in Seldovia. These were added at the request of the other partner tribes and EPA. Species were: beluga, snails, pike, smelt, whitefish, needlefish, and bullhead. Parts were: belly flaps/meat for fish and blubber/fat for harbor seals. The cooking method added was salted. We do not feel these had significant impacts on the overall results because it is known that the additional fish species and non-fish species added are rarely, if at all, consumed by SVT members. It is also known that fish are rarely salted by SVT members. The majority of SVT members specified "oil" in the "other" parts consumed category when asked this question for harbor seal, so it was easy to distinguish that they did in fact eat blubber/fat from the seal since these are the parts rendered into oil. Data for fish parts were analyzed separately for Seldovia and the other villages to avoid confusion although it is possible that "belly flaps/meat" would have been a popular part consumed by Seldovia tribal members if it had been presented to them as an option.

8.2 Comparisons

8.2.1 Comparisons with the estimated national fish consumption rate for the U.S. population

Currently, in Alaska, the Department of Environmental Conservation (ADEC) uses a 6.5 g/day fish consumption rate to calculate human health criteria (Powell 2011). The Environmental Protection Agency (EPA) uses a national fish consumption rate of 17.5 g/day to establish water quality criteria (Powell 2011). According to results from this assessment, the average fish consumption rate of Cook Inlet village tribal members is approximately 5 times greater than the average consumption rate estimated for the general U.S. population by EPA and 15 times greater than the rate used by ADEC. The rates of tribal members' consumption across gender, age groups, fish consumers only, seasons, mothers who are nursing or have nursed all are above the national estimate. These results suggest the EPA and ADEC's adopted water quality standards based on the present consumption rates may not be sufficient to protect the health of tribal members who catch and consume fish caught in the Cook Inlet area.

8.2.2 Comparison of rates from other surveys/studies

Port Graham conducted a dietary survey of tribal members in 2004. Respondents were asked to estimate the amount of fish and other subsistence foods they ate in a year (in lbs). Port Graham then provided this information to the Agency for Toxic Substances and Disease

Registry (ATSDR) as part of the contaminant study (ATSDR 2009). They had 44 participants (12 elders, 28 adults, and 4 teenagers).

The Columbia River Basin tribes (Umatilla, Nez Perce, Yakama, and Warm Springs) conducted a fish consumption survey of their tribal members (which the methodology and questionnaire in this assessment followed) in 1991-1992. In total, they surveyed 513 adult tribal members (18 years old or older) and obtained dietary information for 204 children (ages 5 years old or younger). Their survey did not include non-fish subsistence species.

The comparisons SVT could make with Port Graham's 2004 data and the data collected in this assessment were limited to fish consumption rates for elders, adults, and teenagers because information regarding seasonality, ceremonies, breastfeeding, fish preparation/cooking methods, and fish consumption by children younger than teenagers were not collected in 2004.

8.2.2.1 Adult rates of fish consumption

Port Graham

Elders were estimated to consume approximately 256 g/day (n=12) and adults approximately 199 g/day (n=28).

Columbia River Basin Tribes

The fish consumption rate of adult tribal members estimated for the Columbia River Basin tribes was 58.7 (± 3.64 SE) g/day (*weighted*, n=500).

Comparison with Cook Inlet Tribes

Based upon this assessment, adult tribal members were estimated to consume 94.8 (± 23.55 SE) g/day of fish, a higher rate than Columbia River Basin tribes. Several factors may account for this. Native Alaskans living in Cook Inlet may rely more heavily on subsistence foods (in general) than Columbia River Basin tribal members due to stronger cultural or income influences and/or more limited accessibility to grocery stores (due to both transportation and income factors). The role that terrestrial-based subsistence foods have on diet, compared to marine subsistence foods, may also differ between Columbia River Basin and Cook Inlet tribes due to availability and accessibility. The average rate of fish consumption, overall, for Cook Inlet members was lower than what was found in the survey conducted by Port Graham for their tribal members. However, it should be noted that the average rate of fish consumption found for Port Graham tribal members between the ages of 40-59 (281.1 (± 213.7 SE) g/d) (n=5) in this assessment supported the rates found in their earlier survey. Differences in survey results may be due to differences in methodology. Their survey in 2004 required tribal members to recall fish consumption patterns on an annual (yearly) basis, and in lbs, instead of on a weekly or monthly basis and in ounces. Food models were also not used in 2004 nor were surveys conducted in-person but rather filled out by respondents and mailed in. A lot of

variation in fish consumption patterns existed among Cook Inlet villages, as well, which would have greatly influenced the overall average rate of fish consumption.

Differences in the demographics of respondents were also apparent between Cook Inlet and Columbia River Basin tribal members. In the Columbia River Intertribal Fish Commission survey, the largest number of respondents fell within the age category between 18-29 years old whereas the majority of respondents in this assessment were between the ages of 30-49 years old (31/76 or 44.6%).

An equal number of males and females participated in this assessment (n=38 for each gender) while more females participated in the survey conducted by the Columbia River Basin tribes. While they found that elders (60^{+} years old), on average, consumed more fish (g/d) than any other age group (18-39 years old, 40-59 years old), this was not true for Cook Inlet tribes. On average, respondents between the ages of 40-59 years old, followed by 18-39 years old, ate the most fish per day (109.6 (± 48.91 SE) g/d and 105.8 (± 41.67 SE) g/d respectively). Similarities in results between the Columbia River Basin tribes and the Cook Inlet tribes were that, on average, males consumed more fish (g/d) than females (see Figure 4), tribal members who fished consumed more fish than non-fishers (see Figure 4), and salmon was the most consumed fish by tribal members (see Figures 8-12).

8.2.2.2 Seasonal fish consumption

Columbia River Basin Tribes

Almost 42 percent (*weighted*) of respondents indicated that the most fish was consumed during the months of April through July. For all months identified as high fish consumption months by the entire population sampled (i.e., fish consumers and non-fish consumers combined) respondents (n=508) consumed an average of 87.9 (± 4.80 SE) g/d (*weighted*) of fish. For approximately 26 percent of respondents, the two months of highest fish consumption were either May and June, June and July, or July and August and the months of May and June were the most frequently chosen high fish consumption months.

When asked about the months of lowest fish consumption, 56.7% (*weighted*) of respondents indicated that they eat the least fish during the months of November through February. Approximately 28% (*weighted*) of respondents estimated either January and February, January and November, or November and December as their two months of least fish consumption. Overall, the two most frequently cited months of low consumption were December and January. For all months identified as low fish consumption months by the entire population sampled, respondents (n=484) consumed an average of 26.4 (± 1.39 SE) g/d (*weighted*).

Comparison with Cook Inlet Tribes

For Cook Inlet tribes, approximately 52 percent (51.9% or 40/76) of respondents indicated the two months of highest fish consumption as either June and July or July and August. For both

Cook Inlet and the Columbia River Basin tribes, the migration months of salmon within local areas coincides with months of high fish consumption as well as an increase in tribal/community events. Approximate timing of salmon runs for both the Columbia River and the Kenai Peninsula are provided below:

Table 3. Salmon species and migration times for Columbia River and Kenai Peninsula.(Data provided by Columbia River Inter-Tribal Fish Commission 1994 report and the website, www.piscatorialpursuits.com/akfishruns.htm).

Salmon Species	Columbia River	Kenai Peninsula
Chinook	March-November	June-July
Sockeye	May-August	June-August
Coho	August-November	August-October

Since runs of salmon on the Kenai Peninsula of Alaska occur later than in the Columbia River, it is not surprising that high fish consumption months in Cook Inlet would follow slightly behind that of the Columbia River Basin.

When asked about the months of lowest fish consumption, approximately 63 percent (63.2% or 47/76) of respondents indicated that they eat the least fish during the months of November through May with January being cited the most frequently as a month of least fish consumption. While this result is very similar to the results obtained by the Columbia River Intertribal Fish Commission survey, Cook Inlet tribal members consume more fish (g/d), on average, during both high and low fish consumption months than Columbia River Basin tribal members (see Figures 6 and 7).

8.2.2.3 Sources of fish

Columbia River Basin Tribes

About half of the Columbia River Basin Tribes (48.7% or 253/498; *weighted*) survey respondents indicated they fish for personal consumption or for use by their tribe and on average, respondents obtained 87.6 (± 1.1 SE) percent of fish from the following sources combined: self-harvesting, harvesting by family members, friends, ceremonies, and tribal distributions. Survey respondents obtained the most fish through self-harvesting or family.

Comparison with Cook Inlet Tribes

For tribal members in Cook Inlet, the percentage of respondents who fish (92.1% or 68/76) was much higher than Columbia River Basin tribal members and on average, tribal members obtained 96.7(± 1.80 SE) percent (n=76) of their fish from the combined sources of harvesting by themselves or their families, friends, ceremonies, and tribal distribution. Similar to Columbia River Basin tribal members, Cook Inlet tribal members obtain the largest percentage of their fish through self-harvesting or family. A larger proportion of Cook Inlet tribal members may fish than members of the Columbia River Basin tribes due to access to the ocean, cultural values, more limited access to grocery stores and other food sources and higher grocery costs.

8.2.2.4 Ceremonial use of fish

Columbia River Basin Tribes

A large percentage (93.3% or 480/512; *weighted*) of Columbia River Basin tribal members indicated they attend ceremonies or traditional events and over half of these individuals (52.4% or 187/512; *weighted*) attend ceremonies at least 1-3 times per month. Of the tribal members who do attend ceremonies/events, 72.6% (344/480; *weighted*) consume fish during these occasions.

Comparison with Cook Inlet Tribes

Cultural events, such as tribal ceremonies and potlatches, are an integral part of tribal culture and can influence the rate of fish consumption. Although quotas of fish are often not given to tribal members by the participating Cook Inlet tribes in this assessment, tribal members frequently receive fish from their tribes through meal programs and sponsored community events (like potlatches, holiday celebrations). At 90.1% (67/76), the proportion of respondents who attend ceremonies and/ or community events is very similar to Columbia River Basin tribes. While Cook Inlet tribal members do not attend events/ceremonies as frequently as Columbia River Basin tribal members (the majority (45.2% or 35/76) attending such events less than once a month), a greater proportion of them do eat fish (86.9% or 58/67) while in attendance.

8.2.2.5 Children

Port Graham

Teenagers (17 years old and younger) were estimated to consume approximately 142 g/day (n=4).

Columbia River Basin Tribes

Children (5 years old or younger) were found to eat about 19.6 (± 1.94 SE) g/d (n=194).
Comparison with Cook Inlet Tribes

Children (17 years old and younger) of Cook Inlet tribal households were found, on average, to consume about 78.2 (± 30.85 SE) g/d (n=35).

Since this assessment obtained dietary information from children older than 5 years old, as well as younger than 5 years old, it was not unexpected that the fish consumption rates were higher than what was found for children in the Columbia River Intertribal Fish Commission survey since older children, in general, are expected to consume more food.

Similar to the dietary information collected for children in Columbia River Basin tribal households, dietary patterns of children in Cook Inlet tribal households closely "mimicked" that of the parents and salmon was the most consumed fish species. Interestingly, though, children in Cook Inlet tribal households appear to begin consuming fish at a slightly earlier age than children in Columbia River Basin tribal households. The average age that children of Columbia River Basin tribal members began eating fish was 13.1 (± 0.71 SE) months (n=167) vs. 11.8 (± 2.58 SE) months (n=30) for those residing in Cook Inlet.

Children in Cook Inlet tribal households are breast-fed for a longer time than children in Columbia River Basin tribal households. The average age children stopped being breast-fed in Columbia River Basin tribal households was 7.64 (± 0.62 SE) months (n=99) vs. 11.48 (± 2.31 SE) months (n=25). It is important to note that for both Cook Inlet tribal members and Columbia River Basin tribal members, the breast feeding questions were asked of all female respondents who had given birth, regardless of when they had given birth. Therefore, there may be considerable memory recall error if a long time has passed since a respondent had given birth.

The proportion of female respondents in this assessment who breast-fed was also higher than in the Columbia River Basin. In the Columbia River Intertribal Fish Commission survey, of the 88 percent (242/275; *weighted*) of female respondents who had given birth, approximately 42 percent (103/239; *weighted*) indicated that they were currently breast-feeding or have breast-fed their children. For Cook Inlet female respondents, 96.3% or 36/37 said they had given birth. Out of those women, approximately 68 percent (25/35) said they had breast-fed their youngest child. Cultural values, education, expense, and access to baby formula may all be contributing to long breast-feeding periods and to the popularity of breast-feeding among female tribal members.

8.2.2.6 Adult consumption of non-fish subsistence foods

Port Graham

Average individual consumption of clams/mussels was estimated at about 2.83 g/d and 25.51 g/d for other invertebrates (chiton, snails, octopus). Children were assumed to eat about half to one-third as much as adults.

Comparison with Cook Inlet Tribes

Based upon the proportion of respondents who eat the above mentioned subsistence foods, as well as how frequently they do so, the results of this assessment support that chitons, clams, octopus, and snails are priority non-fish subsistence foods for Cook Inlet tribes.

8.3 Recommendations and future studies

As is evident from the results obtained from this assessment, the average fish consumption rate of Seldovia, Port Graham, Nanwalek, and Tyonek surveyed tribal members is

approximately 5 times greater than the average consumption rate estimated for the general U.S. population by EPA and 15 times greater than the rate used by ADEC in calculating human health based ambient water quality criteria and standards for toxins. These results suggest that EPA's and state adopted ambient water quality criteria and standards for toxic pollutants based on the national estimated fish consumption rates may not be sufficient to protect Native Alaskans residing in Cook Inlet.

The consumption rates established in this report should ideally be combined with site-specific fish tissue monitoring data to determine tribal members' actual exposure to toxic pollutants. SVT hopes to undertake such a project in the near future (2013-2014).

Based on this assessment, we would suggest that in future dietary surveys focusing on Cook Inlet villages, that sea lion, razor clams, and gumboot chitons be included as subsistence foods since they were reported as being commonly eaten during this assessment. We would also suggest that non-fish subsistence species be quantified in terms of lbs for consistency and simplicity.

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